J.J COLLEGE OF ARTS AND SCIENCE (Autonomous), Pudukkottai – 622 422

DEPARTMENT OF CHEMISTRY

M.Sc. CHEMISTRY

Proposed Course Structure based on UGC-LOCF and TANSCHE

(Choice Based Credit System)

(Applicable for the candidates admitted from academic year **2023-2024** onwards)

SEMESTER - I

Course Code	Course Title	Hrs./ Week	Credit	Exam Hrs.	Marks		Total
					Int.	Ext.	
P1R3CHCC1	Organic Reaction Mechanism-I	7	5	3	25	75	100
P1R3CHCC2	Structure and Bonding in Inorganic Compounds	7	5	3	25	75	100
P1R3CHCC3P	Organic Chemistry Practical	6	4	6	40	60	100
P1R3CHDSE1:1/ 1:2	Pharmaceutical Chemistry/Nanomaterials and Nanotechnology	5	3	3	25	75	100
P1R3CHDSE2:1/ 2:2	Electrochemistry/ MolecularSpectroscopy	5	3	3	25	75	100
	Total	**30**	**20**				**500**

SEMESTER – II							
P2R3CHCC4	Organic Reaction Mechanism-II	6	5	3	25	75	100
P2R3CHCC5	PhysicalChemistry-I	6	5	3	25	75	100
P2R3CHCC6P	Inorganic Chemistry Practical	6	4	6	40	60	100
P2R3CHDSE3:1/3:2	Medicinal Chemistry/Green Chemistry	4	3	3	25	75	100
P2R3CHDSE4:1/4:2	Bioinorganic Chemistry/Material Science	4	3	3	25	75	100
P2R3CHSEC 1:1/1:2	Preparation of Consumer products / Chemistry in everyday life	4	2	3	25	75	100
	Total	**30**	**22**				**600**

SEMESTER – III							
P3R3CHCC7	Organic Synthesis and Photochemistry	5	5	3	25	75	100
P3R3CHCC8	Coordination Chemistry-I	5	5	3	25	75	100
P3R3CHCC9	Physical Chemistry – II	5	5	3	25	75	100
P3R3CHCC10P	Physical Chemistry Practical	5	5	6	40	60	100
P3R3CHDSE 5:1/5:2	Chemistry of natural Products / Pharmacognosy and Phytochemistry	5	3	3	25	75	100
P3R3CHSEC 2:1/ 2:2	Polymer Chemistry / Biomolecules and Heterocyclic compounds	5	2	3	25	75	100
P3R3CHINT	Internship	-	3	-	-	-	100
	Total	**30**	**28**	**-**	**-**	**-**	**700**
SEMESTER – IV							
P4R3CHCC11	Coordination Chemistry-II	6	5	3	25	75	100
P4R3CHCC12	Analytical Chemistry	6	5	3	25	75	100
P4R3CHCC13PW	Project Work	18	10	-	-	-	100
	Total	**30**	**20**				**300**
	Grand Total		**90**				**2100**

Title of the Course	**ORGANIC REACTION MECHANISM – I**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Core Course**	**Hrs/Week :07**
Course Code	**P1R3CHCC1**	**Total Inst. Hrs :105**
Nature of the Course :	**Skill Development**	**Sem: I Credit: 05**

Objectives of the course :

1 To understand the feasibility and the mechanism of various organicreactions.

2 To comprehend the techniques in the determination of reactionmechanisms.

3 To understand the concept of stereochemistry involved in organiccompounds.

4 To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.

5 To design feasible synthetic routes for the preparation of organiccompounds.

UNIT-I: Methods of Determination of Reaction Mechanism: (21 Hours)

Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate. Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism. Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.

UNIT-II: Aromatic and Aliphatic Electrophilic Substitution: (21 Hours)

Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions. Aliphatic electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidences.

UNIT-III: **Aromatic and Aliphatic Nucleophilic Substitution: (21 Hours)**

Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attacking nucleophile. Reactions: Oxygen and Sulphur-nucleophiles,Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements. S_N1, ion pair, S_N2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon.S_N1, S_N2, S_Ni, and S_E1 mechanism and evidences, Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles

UNIT-IV: Stereochemistry-I: (21 Hours)

Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining theconfiguration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation. D, L system, Cram's and Prelog's rules: R, S-notations, proR, proS, side phase and re phase Cahn-Ingold- Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes. Topicity and prostereoisomerism, chiral shift reagents and chiral solvating reagents. Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction.Stereoselective and stereospecific synthesis.

UNIT-V: Stereochemistry-II: (21 Hours)

Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle. Stability of five and six-membered rings: mono-, di- and polysubstituted cyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule. Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.

RecommendedText

1. J. March and M. Smith, Advanced Organic Chemistry, 5th edition, John-Wiley and Sons.2001.
2. E. S. Gould, Mechanism and Structure in Organic Chemistry, Holt, Rinehart and Winston Inc., 1959.
3. P.S.Kalsi, Stereochemistry of carbon compounds, 8th edition, New Age International Publishers, 2015.
4. P. Y. Bruice, Organic Chemistry, 7th edn, Prentice Hall, 2013.
5. J.Clayden, N. Greeves, S. Warren, Organic Compounds, 2nd edition, Oxford University Press, 2014.

ReferenceBooks

1. F.A. Carey and R.J. Sundberg, Advanced Organic Chemistry Part-A and B, 5th edition, Kluwer Academic / Plenum Publishers, 2007.
2. D. G. Morris, Stereochemistry, RSC Tutorial Chemistry Text 1, 2001.
3. N.S. Isaacs, Physical Organic Chemistry, ELBS, Longman, UK, 1987.
4. E. L. Eliel, Stereochemistry of Carbon Compounds, Tata-McGrawHill, 2000.
5. I. L. Finar, Organic chemistry, Vol-1 & 2, 6th edition, PearsonEducation Asia, 2004.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able

- **CLO1**: To recall the basic principles of organic chemistry.
- **CLO2**: To understand the formation and detection of reaction intermediates of organic reactions.
- **CLO3**: To predict the reaction mechanism of organic reactions and stereochemistry oforganic compounds.
- **CLO4**: To apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.
- **CLO5**:To design and synthesize new organiccompounds by correlating thestereochemistry of organic compounds.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

Strong – 3 Medium-2 Low-1

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 – Low

Title of the Course	**STRUCTURE AND BONDING IN INORGANIC COMPOUNDS**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Core Course**	**Hrs/Week :07**
Course Code	**P1R3CHCC2**	**Total Inst. Hrs : 105**
Nature of the Course :	**Skill Development**	**Sem: I** **Credit: 05**

Objectives of thecourse

1. To determine the structural properties of main group compounds andclusters.
2. To gain fundamental knowledge on the structural aspects of ioniccrystals.
3. To familiarize various diffraction and microscopic techniques.
4. To study the effect of point defects and line defects in ionic crystals.To evaluate the structural aspects of solids.
5. To evaluate the structural aspects of solids.

UNIT-I: Structure of main group compounds and clusters: (20 Hours) VB theory – Effect of lone pair and electronegativity of atoms (Bent's rule) on the geometry of the molecules; Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade's rule to predict the structure of borane cluster;main group clusters –zintl ions and mno rule.

UNIT-II: Solid state chemistry – I: (22 Hours)

Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis; point group and space group;

Solid state energetics: Lattice energy – Born-Lande equation -Kapustinski equation, Madelung constant

UNIT-III: Solid state chemistry – II: (21 Hours)

Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.

UNIT-IV: Techniques in solid state chemistry: (21 Hours)

X-ray diffraction technique: Bragg's law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.

UNIT-V: Band theory and defects in solids (21 Hours)

Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.

RecommendedText

1. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014.
2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers,Himalaya Publishing House, 2001.
3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.
4. K. F. Purcell and J. C. Kotz, Inorganic Chemistry; W.B. Saunders company: Philadelphia, 1977.
5. J. E. Huheey, E. A. Keiter and R. L. Keiter, Inorganic Chemistry;4th ed.; Harper and Row: NewYork, 1983.

Reference Books

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.

2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.
3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.
4. T. Moeller, Inorganic Chemistry, A Modern Introduction; John Wiley: New York, 1982.
5. D. F. Shriver, P. W. Atkins and C.H. Langford; Inorganic Chemistry; 3rd ed.; Oxford University Press: London, 2001.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able

CO1: Predict the geometry of main group compounds and clusters.

CO2: Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.

CO3: Understand the various types of ionic crystal systems and analyze their structuralfeatures.

CO4: Explain the crystal growth methods.

CO5: To understand the principles of diffraction techniques and microscopic techniques.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 – Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Title of the Course	**ORGANIC CHEMISTRY PRACTICAL**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Core Course**	**Hrs/Week :06**
Course Code	**P1R3CHCC3P**	**Total Inst. Hrs : 90**
Nature of the Course	**Skill Development**	**Sem: I Credit: 04**

Objectives of thecourse

To understand the concept of

1. the separation, qualitative analysis of organic compounds
2. preparation of organic compounds.
3. To develop analytical skill in the handling of chemical reagents for separation of binary and ternary organic mixtures. To analyze the separated organic components systematically and derivative them suitably.
4. To construct suitable experimental setup for the organic preparations involving two stages.
5. To experiment different purification and drying techniques for the compound processing.

UNIT-I: Separation and analysis: Two component mixtures.

Three component mixtures.

UNIT-II: **Estimations:** **(50 Hours)**

a) Estimation of Phenol (bromination)

b) Estimation of Aniline (bromination)

c) Estimation of Ethyl methyl ketone (iodimetry)

d) Estimation of Glucose (redox)

e) Estimation of Ascorbic acid (iodimetry)

f) Estimation of Aromatic nitro groups (reduction)

g) Estimation of Glycine (acidimetry)

h) Estimation of Formalin (iodimetry)

i) Estimation of Acetyl group in ester (alkalimetry)

j) Estimation of Hydroxyl group (acetylation)

k) Estimation of Amino group (acetylation

UNIT-III: Two stage preparations: (40 Hours)

a) *p*-Bromoacetanilide from aniline

b) *p*-Nitroaniline from acetanilide

c) 1,3,5-Tribromobenzene from aniline

d) Acetyl salicyclic acid from methyl salicylate

e) Benzilic acid from benzoin

f) *m*-Nitroaniline from nitrobenzene

g) *m*-Nitrobenzoic acid from methyl benzoate

RecommendedText

1. A R West, Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd., 2014.
2. A K Bhagi and G R Chatwal, A textbook of inorganic polymers, Himalaya Publishing House, 2001.
3. L Smart, E Moore, Solid State Chemistry – An Introduction, 4th Edition, CRC Press, 2012.

Reference Books

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, Concepts and Models in Inorganic Chemistry, 3rd Ed, 1994.
2. R J D Tilley, Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication, 2013.
3. C N R Rao and J Gopalakrishnan, New Directions in Solid State Chemistry, 2nd Edition, Cambridge University Press, 199.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To recall the basic principles of organic separation, qualitative analysis and preparation.

CO2: To explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.

CO3: To determine the characteristics of separation of organic compounds by variouschemical reactions.

CO4: To develop strategies to separate, analyze and prepare organic compounds.

CO5: To formulate a method of separation, analysis of organic mixtures and design suitable

procedure for organic preparations.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Title of the Course :	**PHARMACEUTICAL CHEMISTRY**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Core Course**	**Hrs/Week :05**
Course Code :	**P1R3CHDSE1;1**	**Total Inst. Hrs : 75**
Nature of the Course :	**Skill Development**	**Sem: I Credit: 03**

Objectives of the course

1. To understand the advanced concepts of pharmaceutical chemistry.
2. To recall the principle and biological functions of various drugs.
3. To train the students to know the importance as well the consequences of various drugs.
4. To have knowledge on the various analysis and techniques.
5. To familiarize on the drug dosage and its structural activities.

UNIT-I: Physical properties in Pharmaceuticals: (15 Hours)

Physical properties of drug molecule: physical properties. Refractive index- Definition and importance, specific & molar refraction. Optical activity\rotation- monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity. Dielectric constant & Induced Polarization- Dielectric constant explanation & determination. Rheology of pharmaceutical systems: Introduction, Definition, Applications,

UNIT-II: Isotopic Dilution analysis: (15 Hours)

principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization. Physico Chemical Properties and drug action. (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.

UNIT-III: Drug dosage and product development: (15 Hours)

Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms. Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies,

UNIT-IV: Development of new drugs: (15 Hours)

Introduction, procedure followed in drug design, Structure-Activity Relationship (SAR): Factors effecting bioactivity; theories of drug activity, occupancy theory, rate theory, induced-fit theory, Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables

UNIT-V: Computers in Pharmaceutical Chemistry: (15 Hours)

Need of computers for chemistry. Computers for Analytical Chemists. Docking-Definition, methods- regid and flexible methods, prediction of binding modes, protein-ligand binding free energies, docking score and validation, online ADMET properties.

Recommended Text

1. Physical Chemistry- Bahl and Tuli.
2. Text Book of Physical Pharmaceutics, IInd edition, Vallabh Prakashan-. C.V.S. Subramanyam.
3. Medicinal Chemistry (Organic Pharmaceutical Chemistry), G.R Chatwal, Himalaya Publishing house.
4. Instrumental method of Analysis: Hubert H, Willard, 7th edition.

Textbook of Pharmaceutical Chemistry by, Jayshree Ghosh, S. Chand & company Ltd.

5. Pharmaceutical Chemistry by Dr. S. Lakshmi, Sultan chand & Sons

Reference Books

1. Computers in chemistry, K.V. Raman, Tata Mc.Graw-Hill, 1993.
2. Computers for Chemists, S.K Pundir, Anshu bansal, A pragate prakashan., 2 nd edition, New age international (P) limited, New Delhi.

3. Physical Pharmacy and Pharmaceutical Sciences by Martins, Patrick J. Sinko, Lippincott. William and Wilkins.

4. Cooper and Gunn's Tutorial Pharmacy ,6th edition by S.J. Carter, CBS Publisher Ltd.

5. Ansels pharmaceutical Dosage forms and Drug Delivery System by Allen Popvich and Ansel,

Indian edition-B.I. Publication Pvt. Ltd.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To identify the suitable drugs for various diseases.

CO2: To apply the principles of various drug action and drug design.

CO3: To acquire the knowledge on product development based on SAR.

CO4: To apply the knowledge on applications of computers in chemistry.

CO5: To synthesize new drugs after understanding the concepts SAR.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3

CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Title of the Course	**NANO MATERIALS AND NANO TECHNOLOGY**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Discipline Specific Elective I**	**Hrs/Week :05**
Course Code	**P1R3CHDSE1:2**	**Total Inst. Hrs : 75**
Nature of the Course	**Skill Development**	**Sem: I Credit: 03**

Objectives of thecourse

1. To understand the concept of nano materials and nano technology.
2. To understand the various types of nano materials and their properties. To understand the applications of synthetically important nano materials.
3. To correlate the characteristics of various nano materials synthesized by New technologies.
4. To design synthetic routes for synthetically used new nano materials
5. To know the applications of nano particles in different fields

UNIT-I: **(15 Hours)**

Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis- Bottom –Up, Top–Down, consolidation of Nano powders. Features of nanostructures, Background of nanostructures. Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies.

UNIT-II: **(15 Hours)**

Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis- Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvo thermal and hydrothermal-CVD-types, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.

UNIT-III: **(15 Hours)**

Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina - synthesis and properties.

UNIT-IV: **(15 Hours)**

Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Classification of magnetic phenomena. Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS,PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell

UNIT-V: **(15 Hours)**

Nano thin films, nanocomposites. Application of nanoparticles in different fields. Core-shell nanoparticles - types, synthesis, and properties. Nanocomposites - metal-, ceramic- and polymer-matrix composites-applications. Characterization – SEM, TEM and AFM - principle, instrumentation and applications

RecommendedText

1. S.Mohan and V. Arjunan, Principles of Materials Science, MJPPublishers, 2016.
2. Arumugam, Materials Science, Anuradha Publications,2007.
3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010
4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012.

5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science for Engineers. 6th ed., PEARSON Press, 2007

Reference Books

1. S.Mohan and V. Arjunan, Principles of Materials Science, MJPPublishers, 2016.
2. Arumugam, Materials Science, Anuradha Publications,2007.
3. Giacavazzo et. al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications, 2010
4. Woolfson, An Introduction to Crystallography, Cambridge University Press, 2012.

James F. Shackelford and Madanapalli K. Muralidhara, Introductionto Materials Science for Engineers. 6th ed., PEARSON Press, 2007.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To explain methods of fabricating nanostructures.

CO2: To relate the unique properties of nanomaterials to reduce dimensionality of the material.

CO3: To describe tools for properties of nanostructures.

CO4: To discuss applications of nanomaterials.

CO5: To understand the health and safety related to nanomaterial.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S	S	S	S	M	S	S	S	S	M
CO 2	M	S	S	S	S	M	S	S	S	S
CO 3	S	S	M	S	S	S	S	M	S	S
CO 4	M	S	S	S	S	M	S	S	S	S
CO 5	M	S	M	S	S	M	S	M	S	S

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Title of the Course	**ELECTRO CHEMISTRY**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Discipline Specific Elective II**	**Hrs/Week :05**
Course Code	**P1R3CHDSE2;1**	**Total Inst. Hrs : 75**
Nature of the Course	**Skill Development**	**Sem: I Credit: 03**

Objectives of thecourse

1. To understand the behavior of electrolytes in terms of conductance, ionic atmosphere, interactions.
2. To familiarize the structure of the electrical double layer of differentmodels.
3. To compare electrodes between current density and over potential.To discuss the mechanism of electrochemical reactions.
4. To highlight the different types of over voltages and its applications in electroanalytical techniques.
5. To know about the Polarography, Cyclic voltammetry and Fuel cells

UNIT-I: Ionics: **(15 Hours)**

Arrhenius theory -limitations, van't Hoff factor and its relation to colligative properties. Deviation from ideal behavior. Ionic activity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength, Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ion solvent and ion-ion interactions. Born equation. Debye-Huckel Bjerrum model. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications. Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations. Evidence for ionic atmosphere. Ion association and triple ion formations.

UNIT-II: **(15 Hours)**

Electrode-electrolyte interface: Interfacial phenomena - Evidences for electrical double layer, polarizable and non-polarizable interfaces, Electrocapillary phenomena - Lippmann equation electro capillary curves. Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and sedimentation potentials, colloidal and poly electrolytes. Structure of double layer: Helmholtz -Perrin, Guoy-Chapman and Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations.

UNIT-III: **(15 Hours)**

Electrodics of Elementary Electrode Reactions: Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Cathodic currents, condition for the discharge of ions. Nernst equation, polarizable and non-polarizable electrodes. Model of three electrode system, over potential. Rate of electro chemical reactions: Rates of simple elementary reactions. Butler-Volmer equation- significance of exchange current density, net current density and symmetry factor. Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots

UNIT-IV: **(15 Hours)**

Electrodics of Multistep Multi Electron System: Rates of multi-step electrode reactions, Butler - Volmer equation for a multi-step reaction. Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination, Stoichiometric number. Electro-chemical reaction mechanisms-rate expressions, order, and surface coverage. Reduction of I^{3-}, Fe^{2+}, and dissolution of Fe to Fe^{2+}.

Overvoltage - Chemical and electro chemical,Phase, activation and concentration over potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.

UNIT-V: (15 Hours)

Concentration Polarization, Batteries and Fuel cells: Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarography- principle and applications. Principle of square wave polarography. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Mechanism of charge storage: conversion and alloying. Capacitors- mechanism of energy storage, charging at constant current and constant voltage. Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells.

Recommended Text

1. D. R. Crow, Principles and applications of electrochemistry, 4thedition, Chapman & Hall/CRC, 2014.
2. J. Rajaram and J.C. Kuriakose, Kinetics and Mechanism of chemical transformations Macmillan India Ltd., New Delhi, 2011.
3. S. Glasstone, Electro chemistry, Affiliated East-West Press, Pvt., Ltd., New Delhi, 2008.
4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, Electrochemistry-Principles and applications,S. Viswanathan Printers, Chennai,2007.
5. Joseph Wang, Analytical Electrochemistry, 2nd edition, Wiley,2004.

Reference Books

1. J.O.M. Bockris and A.K.N. Reddy, Modern Electro chemistry, vol.1 and 2B, Springer, Plenum Press, New York, 2008.
2. J.O.M. Bockris, A.K.N. Reddy and M.G. Aldeco Morden Electro chemistry, vol. 2A, Springer, Plenum Press, New York, 2008.
3. Philip H. Rieger, Electrochemistry, 2nd edition, Springer, NewYork, 2010.
4. L.I. Antropov, Theoretical electrochemistry, Mir Publishers, 1977.
5. K.L. Kapoor, A Text book of Physical chemistry, volume-3,Macmillan, 2001.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models.

CO2: To predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations

CO3: To study different thermodynamic mechanism of corrosion,

CO4: To discuss the theories of electrolytes, electrical double layer, electrodics and activity coefficient of electrolytes

CO5: To have knowledge on storage devices and electrochemical reaction mechanism.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3

Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Title of the Course	**MOLECULAR SPECTROSCOPY**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Discipline Specific Elective II**	**Hrs/Week :05**
Course Code	**P1R3CHDSE 2:2**	**Total Inst. Hrs : 75**
Nature of the Course	**Skill Development**	**Sem: I Credit: 03**

Objectives of thecourse

1. To understand the influence of rotation and vibrations on the spectra of the polyatomic Molecules.
2. To study the principle of Raman spectroscopy, ESR spectroscopy, EPR spectroscopy and fragmentation patterns in Mass spectroscopy.
3. To highlight the significance of Franck-Condon principle to interpret the selection rule, intensity and types of electronic transitions.
4. To interpret the first and second order NMR spectra in terms of splitting and coupling patterns using correlation techniques such as COSY, HETCOR, NOESY.
5. To carry out the structural elucidation of molecules using different spectral techniques.

UNIT-I: Rotational and Raman Spectroscopy: (15 Hours)

Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theoryof the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect,

Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches,.

UNIT-II: Vibrational Spectroscopy: (15 Hours)

Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution. vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies.

UNIT-III: Electronic spectroscopy: (15 Hours)

Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and pre dissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, X ray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems

UNIT-IV: NMR and ESR spectroscopy: (18 Hours)

Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX2, AB types. Vicinal, germinal and long-range coupling-spin decoupling. Nuclear Overhauser effect (NOE), Factors influencing coupling constants . 13CNMR and structural correlations, Satellites. Brief introduction to 2D NMR – COSY, NOESY. Introduction to 31P, 19F NMR. ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy; Spin orbit coupling and significance of g-tensors, zero/non-zero field splitting, Kramer's degeneracy, application to transition metal complexes (having one to five unpaired electrons)

UNIT-V: Mass Spectrometry, and Mossbauer Spectroscopy: (12 Hours)

Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules,. Effect of isotopes on the appearance of mass spectrum . Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.

RecommendedText

1. C. N. Banwell and E. M. McCash, *Fundamentals of Molecular Spectroscopy*, 4th Ed., Tata McGraw Hill, New Delhi, 2000.
2. R. M. Silverstein and F. X. Webster, *Spectroscopic Identification of Organic Compounds*, 6th Ed., John Wiley & Sons, New York, 2003.
3. W. Kemp, *Applications of Spectroscopy*, English Language Book Society, 1987.
4. D. H. Williams and I. Fleming, *Spectroscopic Methods in Organic Chemistry*, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi, 1988.
5. R. S. Drago, *Physical Methods in Chemistry*; Saunders: Philadelphia, 1992.

Reference Books

1. P.W. Atkins and J. de Paula, *Physical Chemistry*, 7th Ed., Oxford University Press, Oxford, 2002.
2. I. N. Levine, *Molecular Spectroscopy*, John Wiley & Sons, New York, 1974.
3. A. Rahman, *Nuclear Magnetic Resonance-Basic Principles*, Springer-Verlag, New York,1986.
4. K. Nakamoto, *Infrared and Raman Spectra of Inorganic and coordination Compounds*, PartB: 5th ed., John Wiley& Sons Inc., New York, 1997.
5. J. A. Weil, J. R. Bolton and J. E. Wertz, *Electron Paramagnetic Resonance*; Wiley Interscience, 1994.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the importance of rotational and Raman spectroscopy.

CO2: To apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules.

CO3: To evaluate different electronic spectra of simple molecules using electronic spectroscopy.

CO4: To outline the NMR, ^{13}C NMR, 2D NMR – COSY, NOESY, Introduction to ^{31}P, ^{19}FNMR and ESR spectroscopic techniques.

CO5: To develop the knowledge on principle, instrumentation and structural elucidation of simple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopy techniques.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 - Low

Level of Correlation between PSO's and CO's

CO /PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15

Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Title of the Course :	**ORGANIC REACTION MECHANISM II**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Core Courses**	**Hrs/Week : 06**
Course Code :	**P2R3CHCC4**	**Total Inst. Hrs: 90**
Nature of the Course :	**Skill Development**	**Sem: II Credit: 05**

Objectives: The course aims at giving an overall view of the

1. concept of aromaticity in benzenoid, non-benzenoid, heterocyclic and annulene compounds.
2. the mechanism involved in various types of organic reactions with evidences.
3. the applications of synthetically important reagents.
4. correlate the reactivity between aliphatic and aromatic compounds
5. the reagents and synthetic reaction

UNIT-I: Elimination and Free Radical Reactions: (18 hours)

Mechanisms: E2, E1,and E1cB mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Reactivity: Effect of substrate, attacking bases, leaving group and medium. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Long-lived and short-lived radicals – Production of radicals by thermal and photochemical reactions, Detection and stability of radicals, characteristics of free radical reactions and free radical, reactions of radicals; polymerization, addition, halogenations, aromatic substitutions ,rearrangements. Reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent

UNIT-II: Oxidation and Reduction Reactions: (18 hours)

Mechanisms: Direct electron transfer, hydride transfer, hydrogen transfer, displacement, addition-elimination, oxidative and reductive coupling reactions.Mechanism of oxidation reactions: Dehydrogenation by quinones, selenium dioxides, ferri cyanide, mercuric acetate lead tetra acetate, permanganate, manganese dioxide, osmium tetroxide, oxidation of saturated hydrocarbons, alkyl groups, alcohols, halides and amines. Reactions involving cleavage ofC-C bonds - cleavage of double bonds, oxidative decarboxylation, allylicoxidation,oxidationbychromiumtrioxide-pyridine,DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide-dicyclohexyl carbo diimide(DMSO-DCCD).Mechanism of reduction reactions:Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyl tinhydrides, Mc-Fadyen-Steven'sreduction,Homogeneoushydrogenation,Hydroborationwithcyclicsystems,MPVandBouveault-Blancreduction.

UNIT-III: Rearrangements: (18 hours)

Rearrangements to electron deficient carbon: Pinacol-pinacolone and semi-pinacolone rearrangements -applications and stereochemistry, Wagner-Meerwein, Demjanov, Dienone-phenol, Baker-Venkataraman, Benzilic acid and Wolff rearrangements. Rearrangements to electron deficient nitrogen:Hofmann,Curtius,Schmidt,Lossen,Beckmannandabnormalrearrangements.Rearrangementstoelectron deficient oxygen: Baeyer-Villiger oxidation and Dakin rearrangements.Rearrangements to electron rich atom: Favorskii, Quasi-Favorskii, Stevens,[1,2]-Wittigand[2,3]-Wittig rearrangements. Fries and Photo Fries rearrangement. Intra molecular rearrangements–Claisen, abnormal Claisen, Cope, oxy-Cope Benzidine rearrangements

UNIT-IV: Addition to Carbon Multiple Bonds: (18 hours)

Mechanisms: (a) Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms-Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen; (b) Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction, Prins reaction. Stereo chemical aspects

of addition reactions.Addition to Carbon-Hetero atom Multiple bonds: Addition of Grignard reagents, organo zinc and organo lithium reagents to carbonyl and unsaturated carbonyl compounds.Mechanism of condensation eactions involving enolates Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.

UNIT-V: Reagents and Modern Synthetic Reactions: (18 hours)

Lithium di iso propylamine (LDA), Azobis iso butyro nitrile (AIBN), Sodium cyano boro hydride ($NaBH_3CN$), *meta*-Chloro perbenzoic acid (m-CPBA), Dimethyl aminio pyridine(DMAP),n-Bu_3SnD, Triethylamine(TEA),Diazobicyclo[5.4.0]undec-7-ene(DBU), Di isopropyl azo dicarboxylate (DIAD), Diethyl azo dicarboxylate(DEAD), *N*-bromo succinimide(NBS), Trifluoro acetic acid (TFA), Tetra methyl piperiridin-1-oxyl(TEMPO), Phenyl trimethyl ammonium tribromide (PTAB). Diazomethane and Zn-Cu, Diethylmaleate(DEM), Copper diacetyl acetonate($Cu(acac)_2$),$TiCl_3$,$NaIO_4$, Pyridinium chloro chromate (PCC), Pyridinium dichromate (PDC),Meisenheimercomplex**.**Suzukicoupling,Heckreaction,Negishireaction,Baylis-Hillman reaction.

Recommended text

1. J.MarchandM.Smith, *Advanced OrganicChemistry*,5thed.,John-Wileyand Sons.2001.
2. E.S.Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc.,1959.
3. P.S.Kalsi, *Stereo chemistry of carbon compounds*,8thedn,NewAge International Publishers,2015.
4. P.Y.Bruice,*OrganicChemistry*,7thedn.,PrenticeHall,2013.
R.T.Morrison, R.N.Boyd, S.K.Bhattacharjee*Organic Chemistry*, 7thedn., Pearson Education,2010.

Reference books

1. S.H.Pine,*Organic Chemistry*,5thedn,McGrawHillInternationalEditionn,1987.
2. L.F.FieserandM.Fieser,*Organic Chemistry*,AsiaPublishingHouse,Bombay,2000.
3. E.S.Gould, *Mechanism and Structure in Organic Chemistry*, Holt, Rinehartand WinstonInc.,1959.
4. T.L.Gilchrist, *Heterocyclic Chemistry*, LongmanPress,1989.
5. J.A.Jouleand K.Mills, *HeterocyclicChemistry*,4thed.,John-Wiley, 2010.

WEBSITE AND e-LEARING COURSE

1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic
2. https://www.organic-chemistry.org/

Course Learning Outcomes (forMappingwithPOsandPSOs)

Students will be able:

- **CO1**:To recall the basic principles of aromaticity of organic and hetero cyclic compounds.
- **CO2**:To understand the mechanism of various types of organic reactions.
- **CO3**:To predict the suitable reagents for the conversion of selective organic compounds.
- **CO4**:To correlate the principles of substitution, elimination, and addition reactions.
- **CO5**:To design new routes to synthesis organic compounds.

CO-PO Mapping (CourseArticulationMatrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3– Strong, 2 –Medium,1-Low

Level of Correlation between PSO's and CO's

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3Strong, 2 Medium,1–Low

Title of the Course :	**PHYSICAL CHEMISTRY-I**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Core Courses**	**Hrs/Week : 06**
Course Code :	**P2R3CHCC5**	**Total Inst. Hrs: 90**
Nature of the Course :	**Skill Development**	**Sem: II Credit: 04**

Objectives: The course aims at giving an overall view of the

1. fundamentals of thermodynamics and the composition of partial molar quantities.
2. the classical and statistical approach of the functions
3. the significance of Maxwell-Boltzman, Fermi-Dirac and Bose-Einstein
4. correlate the theories of reaction rates for the evaluation of thermodynamic parameters.
5. the mechanism and kinetics of reactions.

UNIT I: Classical Thermodynamics: (16 hours)

Partial molar properties-Chemical potential, Gibb's- Duhem equation-binary and ternary systems. Determination of partial molar quantities. Thermodynamics of real gases - Fugacity-determination of fugacity by graphical method. Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation applications of ideal and non-ideal mixtures. Activity and activity coefficients-standard states - determination-vapour pressure, EMF and freezing point methods.

UNIT-II: Statistical thermodynamics: (16 hours)

Introduction of statistical thermodynamics concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics-comparison and applications. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants and equi partiion principle.

UNIT-III: Irreversible Thermodynamics: (12 hours)

Theories of conservation of mass and energy entropy production in open systems by heat, matter and current flow, force and flux concepts. Onsager theory-validity and verification-

Onsager reciprocal relationships. Electro kinetic and thermo mechanical effects-Application of irreversible thermodynamics to biological systems.

UNIT-IV: Kinetics of Reactions: (16 hours)

Theories of reactions-effect of temperature on reaction rates, collision theory of reaction rates, Uni molecular reactions -Lindeman and Christiansen hypothesis- effectiveness of collisions, Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules, time .Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis.

UNIT-V: Kinetics of complex and fast reactions: (15 hours)

Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of H2 – Cl2 & H2 – Br2 reactions (Thermal and Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods electric and magnetic field jump methods -stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic, anionic polymerization - Poly condensation.

Recommended Text

1 .J. Rajaram and J.C. Kuriacose, Thermodynamics for Students of Chemistry, 2nd edition,S.L.N.Chand and Co., Jalandhar, 1986.

2. I.M. Klotz and R.M. Rosenberg, Chemical thermodynamics, 6th edition, W.A. BenjaminPublishers, California, 1972.

3. M.C. Gupta, Statistical Thermodynamics, New Age International, Pvt. Ltd., New Delhi, 1995.

4. K.J. Laidler, Chemical Kinetics, 3rd edition, Pearson, Reprint - 2013.

5. J. Rajaram and J.C. Kuriokose, Kinetics and Mechanisms of chemical transformation,Macmillan India Ltd, Reprint - 2011.

Reference Books

1.D.A. Mcqurrie And J.D. Simon, Physical Chemistry - A Molecular Approach, Viva Books Pvt. Ltd., New Delhi, 1999.

2. R.P. Rastogi and R.R. Misra, Classical Thermodynamics, Vikas Publishing, Pvt. Ltd., New Delhi, 1990.

3. S.H. Maron and J.B. Lando, Fundamentals of Physical Chemistry, Macmillan Publishers, New York, 1974

4. K.B. Ytsiimiriski, "Kinetic Methods of Analysis", Pergamom Press,1996.

5. Gurdeep Raj, Phase rule, Goel Publishing House, 2011.

Website References

1. https://nptel.ac.in/courses/104/103/104103112/

2. https://bit.ly/3tL3GdN

3) http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.

4) https ://swayarn. gov.in/course/64-atomic-structure-and-chemical-bonding

5) https://www.chemtube3d com/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To explain the classical and statistical concepts of thermodynamics.

CO2: To compare and correlate the thermodynamic concepts to study the kinetics of chemical reactions.

CO3: To discuss the various thermodynamic and kinetic determination.

CO4: To evaluate the thermodynamic methods for real gases ad mixtures.

CO5: To compare the theories of reactions rates and fast reactions.

CO-PO Mapping (Course Articulation Matrix)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

Level of Correlation between PSO's and CO's

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted Percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3-Strong, 2- Medium, 1- Low

Title of the Course :	**INORGANIC CHEMISTRY PRACTICAL**	**Marks: CIA: 40 + Ext:60 =100**
	Core Course	**Hrs/Week : 06**
Course Code :	**P2R3CHCC6P**	**Total Inst. Hrs: 90**
Nature of the Course :	**Skill Development**	**Sem:II Credit: 04**

Objectives of the course

1. To understand and enhance the visual observation as an analytical tool for the quantitative estimation of ions.
2. To recall the principle and theory in preparing standard solutions.
3. To train the students for improving their skill in estimating the amount of ion accurately present in the solution
4. To estimate metal ions, present in the given solution accurately without using instruments.
5. To determine the amount of ions, present in a binary mixture accurately

UNIT-I: Analysis of mixture of cations (30 Hours)

Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested.

Group-I W,Tl and Pb.

Group-II Se, Te, Mo,Cu, Bi and Cd.

Group-III Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U

Group-IV Zn, Ni, Co and Mn.

Group-V Ca, Ba and Sr.

Group-VI Li and Mg

UNIT-II: Preparation of metal complexes **(30 Hours)**

Preparation of inorganic complexes:

a. Preparation of tristhiourea copper(I)sulphate

b. Preparation of potassiumtrioxalate chromate(III)

c. Preparation of tetrammine copper(II)sulphate

d. Preparation of Reineck'ssalt

e. Preparation of hexathiourea copper(I)chloridedihydrate

f. Preparation of *cis*-Potassiumtrioxalatediaquachromate(III)

g. Preparation of sodium trioxalatoferrate(III)

h. Preparation of hexathiourea lead(II)nitrate

UNIT-III: Complexometric Titration **(30 Hours)**

1. Estimation of zinc, nickel, magnesium, and calcium.

2. Estimation of mixture of metal ions-pH control, masking and de masking agents.

3. Determination of calcium and lead in a mixture (pH control).

4. Determination of manganese in the presence of iron.

5. Determination of nickel in the presence of iron.

Recommended Text

1. A. Jeya Rajendran, Micro analytical Techniques in Chemistry: Inorganic Qualitative Analysis, United global publishers, 2021.
2. V.V.Ramanujam, *Inorganic Semimicro Qualitative Analysis*; 3rd ed., The National Publishing Company, Chennai, 1974.
3. *Vogel's Text book of Inorganic Qualitative Analysis*,4thed.,ELBS, London.

Reference Books

1. G.Pass, and H.Sutcliffe, *Practical Inorganic Chemistry*; Chapman Hall,1965.
2. W.G.Palmer, Experimental *Inorganic Chemistry*; Cambridge University Press, 1954.

Course Outcomes

Course Name: INORGANIC CHEMISTRY PRACTICAL		**Course Code: P2R3CHCC4P**	**K-Level**
On Successful completion of the course, students will be able to			
CO-1	To identify the anions and cations present in a mixture of salts.		**K3**
CO-2	To apply the principles of semi-micro qualitative analysis to categorize acid radicals and basic radicals.		**K4**
CO-3	To acquire the qualitative analytical skills by selecting suitable confirmatory tests and spot tests.		**K4**
CO-4	To choose the appropriate chemical reagents for the detection of anions and cations.		**K3**
CO-5	To synthesize coordination compounds in good quality		**K3**

Relationship Matrix for course Outcome, Programme Outcomes and Programme Specific Outcomes

Title of the Course: INORGANIC CHEMISTRY PRACTICAL											**Course Code: P2R3CHCC6P**				
Course Outcomes (COs)	**PO**										**PSO**				
	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO10**	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	3	3	3	3	3	3	3	2	3	2	3	3	3	3	3
CO2	2	3	3	3	2	3	3	2	2	2	3	3	3	3	3
CO3	3	3	3	2	3	3	3	2	3	2	3	3	3	3	3
CO4	3	3	3	3	3	3	3	2	2	2	3	3	3	3	3
CO5	3	2	3	3	3	3	3	2	2	3	3	3	3	3	3
Weightage											15	15	15	15	15
Weighted percentage of Course Contribution to POs											3.0	3.0	3.0	3.0	3.0

3-Strong, 2-Medium, 1-Low

Title of the Course :	**MEDICINAL CHEMISTRY**	**Marks: CIA: 40 + Ext:60 =100**
Category of the Course :	**Core Course**	**Hrs/Week :04**
Course Code :	**P2R3CHDSE:3:1**	**Total Inst. Hrs: 60**
Nature of the Course :	**Skill Development**	**Sem:II Credit: 03**

Objectives of the course	**1**.To study the chemistry behind the development of pharmaceutical materials. **2**.To gain knowledge on mechanism and action of drugs. **3**.To understand the need of antibiotics and usage of drugs. **4**.To familiarize with the mode of action of diabetic agents and treatment of diabetes. **5**.To identify and apply the action of various antibiotics.
Course Outline	**UNIT-I: Introduction to receptors: 12hrs** Introduction, targets, Agonist, antagonist, partial agonist. Receptors, Receptor types, Theories of Drug – receptor interaction, Drug synergism, Drug resistance, physicochemical factors influencing drug action.
	UNIT-II: Antibiotics: 12hrs Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicllins and tetracyclins, clinical application of penicillins, cephalosporin. Current trends in antibiotic therapy
	UNIT-III: Antihypertensive agents and diuretics: 12hrs Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride. **UNIT-IV: Blood and heamotological agent** : **12hrs**
	Blood–composition, grouping–physiological functions of plasma proteins – mechanism of clotting; Coagulants – vitamin K, protamine sulphate, drythrombin; Anticoagulants–coumarins, citric acid and heparin; anti fibrinolytic agents–amino caproic acid and tranexamic acid.

	UNIT-V: Analgesics, Antipyretics and Anti-inflammatory Drugs: 12 hrs Introduction, Mechanism of inflammation, classification and mechanism of action and paracetamol, Ibuprofen, Diclofenac .Medicinal Chemistry of Antidiabetic Agents Introduction, Types of diabetics, Drugs used for the treatment, chemical classification, Mechanism of action, Treatment of diabetic mellitus.
Extended Professional Component (is a part of internal component only, Not to be included in the external examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET/ UGC-CSIR / GATE /TNPSC others to be solved (To be discussed during the Tutorial hours)
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.
Recommended Text	1. Wilson and Gisvold's textbook of organic medicinal and pharmaceutical chemistry, 2. Wilson, Charles Owens: Beale, John Marlowe; Block, John H, Lipincott William, 12th edition, 2011. 3. Graham L. Patrick, An Introduction to Medicinal Chemistry, 5th edition, Oxford University Press, 2013. Jaya shree Ghosh, A text book of Pharmaceutical Chemistry, S.ChandandCo.Ltd,1999,1999 edn. 4. O.LeRoy, Natural and synthetic organic medicinal compounds,Ealemi,1976. 5. S.Ashutosh Kar, Medicinal Chemistry, Wiley Eastern Limited, NewDelhi,1993, New edn.

Reference Books	1. Foye's Princles of Medicinal Chemistry, Lipincott Williams, Seventh Edition, 2012 2. Burger's Medicinal Chemistry, Drug Discovery and Development, Donald J. Abraham, David P. Rotella, Alfred Burger, Academic press, 2010. 3. Wilson and Gisvold's Text book of Organic Medicinal and Pharmaceutical Chemistry, John M.Beale Jrand JohnM. Block, Wolters Kluwer, 2011,12thedn. 4. P.Parimoo, A Text book of Medical Chemistry, NewDelhi:CBSPublishers.1995. 5. S.Ramakrishnan, K.G.Prasannan and R.Rajan, Text book of Medical Biochemistry, Hyderabad: OrientLongman.3rd edition,2001.
Website and e-learning source	1. https://www.ncbi.nlm.nih.gov/books/NBK482447/ 2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html 3. https://www.classcentral.com/course/swayam-medicinal-chemistry-12908

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: Predict a drugs properties based on its structure.

CO2: Describe the factors that affect its absorption, distribution, metabolism, and excretion, and hence the considerations to be made in drug design.

CO3: Explain the relationship between drug's chemical structure and its therapeutic properties.

CO4: Designed to give the knowledge of different theories of drug actions at molecular level.

CO5: To identify different targets for the development of new drugs for the treatment of infectious and GIT.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO 2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO 4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO 5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 – Strong, 2 – Medium, 1 – Low

Level of Correlation between PSO's and CO's

CO /PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2 – Medium, 1 - Low

Title of the Course :	**GREEN CHEMISTRY**	**Marks: CIA: 25 + Ext:75 =100**
Category of the Course :	**Core Course**	**Hrs/Week :05**
Course Code :	**P2R3CHDSE3:2**	**Total Inst. Hrs: 75**
Nature of the Course :	**Skill Development**	**Sem:II Credit: 04**

Objectives: **Enable learners**

1. To discuss the principles of green chemistry.
2. To propose green solutions for chemical energy storage and conversion.
3. To Propose green solutions for industrial production of Petroleum and Petrochemicals.
4. To Propose solutions for pollution prevention in Industrial chemical and fuel production, automotive industry and Shipping industries.
5. To Propose green solutions for industrial production of Surfactants, Organic and inorganic chemicals.

UNIT I: **Introduction** **(15hours)**

Introduction- Need for Green Chemistry. Goals of Green Chemistry. Limitations/ of Green Chemistry. Chemical accidents, terminologies, International green chemistry organizations and Twelve principles of Green Chemistry with examples.

Unit II: Origin of Mater (18hours)

Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis-green reagents: dimethyl carbonate. Green solvents: Water ,Ionic liquids-criteria, general methods of preparation, effect on organic reaction. Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in scCO2. Green synthesis-adipic acid and catechol.

Unit III: Pollution **(15hours)**

Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers.

UNIT IV : Green Synthesis **(12 hours)**

Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis.

UNITV: Principle and Instrumentation **(15 hours)**

Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sono chemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.

Recommended Text :

1. Ahluwalia, V.K. and Kidwai, M.R. New Trends in Green Chemistry, Anamalaya Publishers, 2005.

2. W.L.Mc Cabe, J.C. Smith and P. Harriott, Unit Operations of Chemical Engineering, 7thedition, McGraw-Hill, NewDelhi,2005.

3. J.M.Swan and D. St. C. Black, Organometallics in Organic Synthesis, Chapman Hall,1974.

4. V.K.Ahluwalia and R. Aggarwal, Organic Synthesis: Special Techniques, Narosa Publishing House, New Delhi, 2001.

5 A.K.De, Environmental Chemistry, New Age Publications, 2017.

Reference Books

1.Anastas, P.T. and Warner, J.K. Oxford Green Chemistry -Theory and Practical, University Press, 1998

2.Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker, 2001

3.Cann, M.C. and Connely, M.E. Real-World Cases in Green Chemistry, American Chemical

Society, Washington, 2000

4.Ryan, M.A. and Tinnes and, M., Introduction to Green Chemistry, American Chemical Society Washington, 2002.

5. Chandra kanta Bandyopadhyay, An Insight into Green Chemistry, Books and Allied (P) Ltd, 2019.

Web References:

1. https://www.organic-chemistry.org/
2. http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.
3. https://swayarn.gov.in/course/64-atomic-structure-and-chemical-bonding
4. https://www.chemtube3d com/

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To recall the basic chemical techniques used in conventional industrial preparations and in green innovations.

CO2: To understand the various techniques used in chemical industries and in laboratory.

CO3: To compare the advantages of organic reactions assisted by renewable energy sources and non-renewable energy sources.

CO4: To apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted organic synthesis.

CO5: To design and synthesize new organic compounds by green methods.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	S	S	S	S	M
CO2	M	S	S	S	S	M	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	S
CO4	M	S	S	S	S	M	S	S	S	S
CO5	M	S	M	S	S	M	S	M	S	S

Level of Correlation between PSO's and CO's

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted Percentage of Course Contribution to POs	3.0	3.0	3.0	3.0	3.0

3-Strong, 2-Medium, 1-Low

Title of the Course :	**BIO-INORGANIC CHEMISRTY**	**Marks: CIA: 25 + Ext:75 =100**
Category of the Course :	**Core Course**	**Hrs/Week :04**
Course Code :	**P2R3CHDSE4:1**	**Total Inst. Hrs: 60**
Nature of the Course :	**Skill Development**	**Sem:II Credit: 03**

Objectives: The course aims at giving an overall view of the

1. Role of trace elements.
2. biological significance of iron, sulpur and the toxicity of metals in medicines.
3. diagnostic agents.
4. Various metals in medicine
5. properties of enzymes

UNIT-I: Essential trace elements: (12 hours)

Selective transport and storage of metal ions: Ferritin, Transferrin and sidorphores; Sodium and potassium transport, Calcium signalling proteins. Metallo enzymes: Zinc enzymes–carboxypeptidaseandcarbonicanhydrase.Ironenzymes–catalase, peroxidase. Copper enzymes–super oxide dismutase, Plastocyanin,Ceruloplasmin,Tyrosinase.Coenzymes-Vitamin-B12 coenzymes

UNIT-II: Transport Proteins: (12 hours)

Oxygen carriers-Hemoglobin and myoglobin - Structure and oxygenation Bohr Effect. Binding of CO, NO, CN– to Myoglobin and Hemoglobin. Biological redox system:Cytochromes-Classification, cytochrome a, b and c. Cytochrome P-450.Non-hemeoxygencarriers-Hemerythrin and hemocyanin. Iron-sulphur proteins-Rubredoxin and Ferredoxin-Structure and classification.

UNIT-III: Nitrogen fixation (12hours)

Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase- redox property – Di nitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction

ofdinitrogentoammonia.Photosynthesis:photosystem-Iandphotosystem-II-chlorophyllsstructureandfunction.

UNIT-IV: Metals in medicine: (12 hours)

Metal Toxicity of Hg, Cd, Zn, Pb, As, Sb. Therapeutic Compounds: Vanadium-Based Diabetes Drugs; Platinum-Containing Anti cancer Agents. Chelation therapy; Cancer treatment. Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents. temperature and critical magnetic Field.

UNIT-V: Enzymes (12hours)

Introduction and properties-nomenclature and classification. Enzyme kinetics, free energy of activation and the effects of catalysis. Michelis-Mentone quation- Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme. Baylis-Hillman reaction.

Recommended text

1. Williams,D.R.–Introduction to Bioinorganic chemistry.
2. F.M. Fiabre and D.R. Williams– The Principles of Bio inorganic Chemistry, Royol Soceity of Chemistry, MonographforTeachers-31
3. K.F.Purcell and Kotz., Inorganic chemistry,WBSaundersCo.,USA.
4. G.N.Mugherjea and Arabinda Das, Elements of Bioinorganic Chemistry-1993.
5. R.Gopalan, V.Ramalingam, *Concise Coordination Chemistry*, S.Chand, **2001**.

Reference books

1. M.Satake and Y.Mido, Bioinorganic Chemistry-Discovery Publishing House, New Delhi (1996)
2. M.N.Hughes, 1982,The Inorganic Chemistry of Biological processes, IIEdition, Wiley London.
3. R.W.Hay, Bio Inorganic Chemistry, Ellis Horwood,1987.
4. R.M.Roat-Malone, Bio Inorganic Chemistry, JohnWiley,2002.
5. T.M.Loehr, Iron carriers and Iron proteins,VCH,1989.

WEBSITE AND e-LEARNING COURSE

1. https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-

series-d162097454.html

https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition- d161563417.html

Course Learning Outcomes (forMappingwithPOsandPSOs)

Students will be able to:

CO1:analyses of trace elements.

CO2:explain the biological redox systems.

CO3: skill in analyzing the toxicity in metals.

CO4:experience in diagnosis.

CO5:nitrogen fixation and photosynthetic mechanism.

CO-PO Mapping (Course Articulation Matrix)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3– Strong, 2 –Medium,1-Low

Level of Correlation between PSO's and CO's

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3– Strong, 2 –Medium,1-Low

Title of the Course :	**MATERIAL SCIENCE**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Discipline Specific Elective**	**Hrs/Week :04**
Course Code :	**P2R3CH DSE4:2**	**Total Inst. Hrs : 60**
Nature of the Course :	**Skill Development**	**Sem: II, Credit: 02**

Objective of the course

1. To understand the crystal structure, growth methods and X-ray scattering.
2. To explain the optical, dielectric and diffusion properties of crystals.
3. To recognize the basis of semiconductors, superconductivity materials and magnets.
4. To study the synthesis, classification and applications of nanomaterial's.
5. To learn about the importance of materials used for renewable energy conversion.

UNIT-I: Crystallography: (12 hrs)

Symmetry-unit cell and Miller indices -crystal systems - Bravais lattices - point groups and space groups -X-ray diffraction-Laue equations-Bragg's law-reciprocal lattice and its application to geometrical crystallography. Crystal structure–powder and single crystal applications. Electron charge density maps, neutron diffraction-method and applications.

UNIT-II: Crystal growth methods: (12 hrs)

Nucleation–equilibriumstabilityandmetastablestate.Singlecrystal–Low and high temperature, solution growth–Gel and sol-gel. Crystal growth methods- nucleation– equilibrium stability and meta stable state. Single crystal–Low and high temperature, solution growth– Gel and sol-gel. Melt growth-Bridgeman-Stock barger, Czochralski methods. Flux technique, physical and chemical vapour transport. Lorentz and polarization factor –primary and secondary extinctions.

UNIT-III: Properties of crystals: (12 hrs)

Optical studies –Electro magnetic spectrum (qualitative) refractive index–reflectance–transparency, translucency and opacity. Types of luminescence – photo-, electro-, and injection luminescence, LEDs – organic, Inorganic and polymer LED materials - Applications. Dielectric studies-Polarisation - electronic, ionic, orientation, and space charge polarisation. Effect of temperature. Dielectric constant, dielectric loss. Types of dielectric breakdown–intrinsic, thermal, discharge, electro chemical and defect breakdown.

UNIT-IV: Special Materials: (12 hrs)

Superconductivity: Meissner effect, Critical temperature and critical magnetic Field, Type I and II superconductors, BCS theory-Cooper pair, Applications. Soft and hard magnets – Domain theory Hysteresis Loop-Applications. Magneto and gian magneto resistance. Ferro, ferri and antiferromagnetic materials-applications, magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials – properties and applications. Shape memory Alloys-characteristics and applications, Non-linear optics-Second Harmonic Generators, mixing of Laser wavelengths by quartz, ruby and $LiNbO_3$.

UNIT-V: Materials for Renewable Energy Conversion: (12 hrs)

Solar Cells Organic, bilayer, bulk heterojunction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photovoltaic cells, coordination compounds anchored onto semiconductor surfaces-Ru(II) and Os(II) poly pyridyl complexes. Photochemical activation and splitting of water, CO2 and N2.Manganese based photo systems for water-splitting. Complexes of Rh, Ru, Pd and Pt-photochemical generation of hydrogen from alcohol.

Recommended Text :

1. S.MohanandV.Arjunan, Principles of Materials Science, MJPPublishers,2016.
2. Arumugam, Materials Science,AnuradhaPublications,2007.
3.Giacavazzo et.al., Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications,2010
4. Woolfson, An Introduction to Crystallography, Cambridge UniversityPress,2012.
5. James F. Shackelford and Madanapalli K. Muralidhara, Introduction to Materials Science forEngineers.6thed, PEARSON Press, 2007.

Reference Books

1. SuggestedReadings1.M.G.Arora,SolidStateChemistry,AnmolPublications,New Delhi, 2001.
2. R.K.Puriand V.K.Babbar, Solid State Physics, S.Chand and Company Ltd, 2001.
3. C. Kittel, Solid State Physics, John-Wiley and sons, NY, 1966.
4. H.P.Meyers, Introductory Solid State Physics, Viva Books PrivateLimited,1998.
5. A.R.West, Solid State Chemistry and Applications, John-Wiley and sons, 1987.

Course Outcomes

Course Name: MATERIALSCIENCE		**Course Code: P2R3CH DSE 4:2**	**K-Level**
On Successful completion of the course, students will be able to			
CO-1	Tounderstandandrecallthesynthesisandcharacteristicsofcrystalstructures, Semi conductors, magnets, nanomaterials and renewable energy materials.		**K4**
CO-2	Tointegrateandassessthestructureofdifferentmaterialsandtheirproperties.		**K3**
CO-3	To analyse and identify new materials for energy applications		**K4**
CO-4	Toexplaintheimportanceofcrystalstructures,piezoelectricandpyroelectric materials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, LED uses, structures and synthesis		**K4**
CO-5	To design and develop new materials with improved property for energy applications.		**K5**

CO-PO Mapping (CourseArticulationMatrix)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3Strong, 2Medium,1low

Level of Correlation between

PSO's and CO's

CO/PO	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3Strong, 2 –Medium,1-Low

Title of the Course :	**PREPARATION OF CONSUMER PRODUCTS**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Skill Enhancement Course**	**Hrs/Week :04**
Course Code :	**P2R3CH SEC 1:1**	**Total Inst. Hrs 60**
Nature of the Course :	**Entrepreneurship**	**Sem: II Credit: 02**

Objective of the course

1. To understand the role of herbs as a source of natural and safe cosmetics.
2. To learn various herbal preparations of cosmetics.
3. Description of several ingredients involved in the production process
4. To increase the ideas of understanding of cosmetic product manufacturing.
5. To identify the Principles of Quality control and standardization of cosmetics

UNITI: INTRODUCTION12 hrs

Introduction to cosmetics, Botanicals in cosmetics, Need and advantages of Herbal cosmetics, Effect of chemical cosmetics, Cosmetics nomenclature: Emulsion, cream, lotion, face wash, face mask, sunscreen; oils and fats used in cosmetics, different bases and raw materials used in cosmetics.

UNITII: HERBALPRODUCTS12 hrs

Extraction of herbal products, A brief account of following herbals or herb extracts of cosmetic importance such as *Acacia concinna*pods, *Aloe Vera*, Almond oil, Neem, *Citrus aurantium* peels, Henna, Turmeric, Liquorice, Olive oil, tea tree oil and wheat germ oil with special emphasis on their source, active principles and cosmetic properties. Anti-aging herbs.

UNITIII: PREPARATION METHODS12 hrs

Face care: Face cleanser, Ache - pimple cream, Preparation of Face pack- any two, Skincare: Skin beauty through pancha karuma, Turmeric - Milk lotion, Aloe vera, Anti – wrinkle cream, Moisturizing cream, Preparation of Herbal Bathing powder, Hair care : Hair oil components and preparation of oil, Role of Karisalankanni, Amla in hair oil preparation, Henna uses, Herbal shampoo, hair dye, preparation of hair spray using essential oils, Foot Care Preparation of foot cream

UNIT IV: NATURAL COLORANTS 12 hrs

Natural colorants: Biological Source, coloring principles, chemical nature and usage of the following Annato, Cochineal, Caramel, Henna, Indigo, Madder, Saffron, Turmeric Flavors and Perfumes: Sandal wood oil, Orange oil, Lemon oil, Vanilla, Palmarosa, geranium oil

UNIT:V QUALITY CONTROL 12 hrs

General Principles of Quality control and standardization of cosmetics-Raw material control, Packaging material control, finished product control, Shelf testing. quality control in cosmetic preparation and guidelines

REFERENCE BOOKS:

1. Andre O. Barel et al., (2009).Handbook of Cosmetic Science and Technology, Informa Health care USA.
2. Mitchell L.Schloss man (Ed.)(2002).The Chemistry and Manufacture of Cosmetics, Allured Publishing Corporation.
3. Meyer R. Rosen (Ed)(2015).Harry's Cosmeticology, 9th Ed. ChemicalPubl. Co.Vimaladevi M. (2018).Text book of Herbal Cosmetics, CBS Publ.
4. International Cosmetic Ingredient Dictionary & Handbook-by The Personal CareProducts Council.
5. P.P. Sharma (5th Ed., 2014).Cosmetics- Formulation, Manufacturing and Quality control.Vandana Publ.
5. H.Panda (2015).Herbal Cosmetics Hand Book, Asia Pacific Business PressInc.
6. P.K Chattopadhyay (2015). Herbal Cosmetics: NIIR. Project Consultancy Services.
7. H.Panda (2016).The Complete Technology Book on Herbal Perfumes and Cosmetics

Course Outcomes

Course Name: PREPARATION OF CONSUMER PRODUCTS	**Course Code: P2R3CH SEC 1:1**	**K-Level**
On Successful completion of the course, students will be able to		
CO-1	Acquire knowledge about role of herbs as a source of natural and safe cosmetics	**K3**
CO-2	Learn the various herbal preparations of cosmetics.	**K4**
CO-3	Understand the preparation of cosmetic drugs.	**K4**
CO-4	: Know about Face care, skin care and hair care.	**K5**
CO-5	Students will learn about the raw materials used in herbal cosmetics and get exposed to various preparations herbal cosmetics.	**K3**

CO-PO Mapping (Course Articulation Matrix)

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**
CO2	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO3	**S**	**S**	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**
CO4	**M**	**S**	**S**	**S**	**S**	**M**	**S**	**S**	**S**	**S**
CO5	**M**	**S**	**M**	**S**	**S**	**M**	**S**	**M**	**S**	**S**

3 Strong, 2 medium,1-Low

Level of Correlation between PSO's and CO's

CO/PO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	3
CO2	3	3	3	3	3
CO3	3	3	3	3	3
CO4	3	3	3	3	3
CO5	3	3	3	3	3
Weightage	15	15	15	15	15
Weighted percentage of Course Contribution to Pos	3.0	3.0	3.0	3.0	3.0

3–Strong, 2 Medium,1-Low

Title of the Course :	**CHEMISTRY OF EVERYDAY LIFE**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Skill Enhancement Course**	**Hrs/Week :04**
Course Code :	**P2R3CH SEC 1:2**	**Total Inst. Hrs 60**
Nature of the Course :	**Skill Development**	**Sem: II Credit: 02**

Objectives: To make students understand

1.*The characteristics of water*

2.*Properties the essential oils,perfumes,flavours*

3.*Cosmetics and their applications*

4.*The components of soap and their properties*

5.*The action of detergents*

Unit-I: Water Chemistry (15 Hrs)

Water- Characteristics of water – Surface water- Ground Water- Atmospheric water -Soft water and Hard water. **Hardness of Water-** Temporary Hardness- Permanent Hardness- Removal of hardness- Ion exchange and reverse osmosis method **Water Quality Parameters and determination** - pH-Electrical Conductivity- Dissolved Oxygen- Chemical Oxygen demand-Biological oxygen demand-Total Dissolved Solids-Alkalinty-SAR**.**

Unit-II: Building materials :(12Hrs)

cement, ceramics, glass and refractories - definition, composition and application only polythene, PVC, bakelite, polyesters, melamine-formaldehyde resins -preparation and only. and refractories - definition, composition and application only. Plastics -, PVC, bakelite, polyesters, melamine-formaldehyde resins -preparation and uses

Unit III:Cosmetics (10 Hrs)

Face cream, sun screen lotion, shaving cream-composition-formulation-uses and their hazard. Sprayer, hand lotion, nail lacquers; nail bleaches, hair oil, hair dyes– Composition, formulation-uses and their hazards.

Unit-IV: Soaps (10 Hrs)

Definition-Types of Soap- Medicated soaps, Herbal soaps. Soft soaps. Shaving soaps - Mechanism of action of soap.-Manufacture of soaps- Saponification of oils and fats- Formulation of toilet soaps. Different ingredients used and their functions. Shaving soap and creams-ISI specifications. Testing procedures/limits.

Unit-V: Detergents **(13 Hrs)**

Anionic Detergents: Manufacture of LAB(linear alkyl benzene). Sulphonation of LAB – preparation of acid slurry. Different ingredients in the formulation of detergent powders and soaps.

Cationic detergents: examples. Manufacture and applications. **Non-ionic detergents**: examples. Manufacture of ethylene oxide condensater. **Mechanism of action of detergents**. Comparison of soaps and detergents.

Text Books:

1. Thangammal Jacob, A textbook of applied chemistry, Mcmillan Company Ind. Ltd, 1997.
2. K.Bagavathi Sundari, Applied Chemistry, MJP publishers Chennai, 1st Ed., 2006.

Reference Books:

1. B.K.Sharma, Industrial Chemistry, Goel Publishing House, 2011.
2. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, 1st Ed., S.Chand Company Ltd – New Delhi, 2010.

CO No.	CO-Statements	K-Level
On Successful completion of the course, students will be able to		
CO-1	learn about in chemistry in everyday life	**K2**
CO-2	set up as small entrepreneurs	**K3**
CO-3	Get awareness on effect of cosmetics, understand more about cosmetics and their uses	**K3**
CO-4	Understand the importance of fuels and fire protection	**K1**
CO-5	appreciate the medicinal uses of chemical products	**K4**

Relationship Matrix for course Outcome, Programme Outcomes and Programme Secific Outcomes

Title of the Course: CHEMISTRY OF EVERYDAY LIFE						Course Code: U4R2CHSEC1:1					
Course Outcomes (Cos)	Programme Outcomes(POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2	3	2	2	3	3	2	2	3	2.3
CO2	3	3	1	3	2	3	2	3	3	3	2.6
CO3	2	1	3	2	2	3	2	2	3	3	2.3
CO4	3	2	1	2	2	3	3	3	3	3	2.5
CO5	3	1	2	3	3	3	3	2	3	3	2.6
	Mean Overall Score										2.46
	Result										High

Title of the Course :	ORGANIC SYNTHESIS AND PHOTOCHEMISTRY	Marks: CIA:25 + Ext:75=100
Category of the Course:	Core course	Hrs/Week :05
Course Code :	P3R3CHCC7	Total Inst. Hrs: 75
Nature of the Course :	Skill Development	Sem: III Credit: 05

Course objectives: This course aims at providing an overall view of the

1. To understand the molecular complexity of carbon skeletons and the presence of functional groups and their relative positions.
2. To study various synthetically important reagents for any successful organic synthesis.
3. To apply disconnection approach and identifying suitable synthons to effect successful organic synthesis.
4. To learn the concepts of pericyclic reaction mechanisms.
5. To gain the knowledge of photochemical organic reactions.

UNIT-I: Planning an Organic Synthesis and Control elements: (15 Hours)

Preliminary Planning – knowns and unknowns of the synthetic systemstudied, analysis of the complex and interrelated carbon framework into simple rationalprecursors, retrosynthetic

analysis, alternate synthetic routes, key intermediates that wouldbe formed, available starting materials and resulting yield of alternativemethods. Linear Vs convergent synthesis. synthesis based on umpolung concepts ofSeeback, regiospecific control elements. Use of protective groups, activating groups and bridgingelements. Examples on retrosynthetic approach, calculation of yield, advantages of convergent, synthesis, synthesis of stereochemistry-controlled products.

UNIT-II: Organic Synthetic Methodology: (15 Hours)

Retrosynthetic analysis; Alternate synthetic routes. Synthesis of organic mono and bifunctional compounds via disconnection approach. Key intermediates, available starting materials and resulting yields of alternative methods. Convergent and divergent synthesis, Synthesis based on umpolung concepts of Seebach. Protection of hydroxyl, carboxyl, carbonyl, thiol and amino groups. Illustration of protection and deprotection in synthesis. Control elements: Regiospecific control elements. Use of protective groups, activating groups, and bridging elements. Stereospecific control elements.

UNIT-III: Pericyclic Reactions: (15 Hours)

Functional group alterations and Concerted Reaction – MO Theory for bonding and anti bonding orbitals – Types of HOMO, LUMO orbitals - Construction of molecular orbitals, symmetry in π Molecular Orbitals, filling of electrons in molecular orbitals, Frontier Molecular Orbitals – Molecular symmetries of 1.3 butadiene, 1,3,5 hexatriene, allylic.

UNIT-IV: Organic Photochemistry-I: (15 Hours)

Photochemistry of carbonyl compounds: Norrish type I and type II reactions, Photoreduction. Photochemistry of α, β and β,γ – unsaturated carbonyl compounds, Photodimerization, Barton reaction and Paterno-buchi reaction. Photochemistry of aromatic compounds: Photochemical isomerization, addition (1,2 additon 1,3 addition 1,4 addition) and substitution (Electrophilic and nucleophilic). Photochemistry of Alkenes: Cis -Trans Isomerization - Photochemistry of Conjugated Dienes. Rearrangement of 1,4 - and 1,5- dienes

UNIT-V: Organic Photochemistry-II: (15 Hours)

Photo oxidation and Photo oxygenation, Singlet molecular reaction, Photo oxidation of alkenes. Photochemical Cyclization, Di - π-methane rearrangement, Aza di – π methane rearrangement, Photo- Fries. Rearrangement, Hoffmann-Loefller-Freytag reaction. Photochemistry of polymers: Photopolymerization, photochemical cross linking of polymers, photodegradation of polymers (vinyl, polyethylene and polypropylene), photostabilisers.

Text Books

1. F. A. Carey and Sundberg, Advanced Organic Chemistry, 5thed, Tata McGraw-Hill, New York, 2003.
2. J. March and M. Smith, Advanced Organic Chemistry, 5th ed., John-Wiley and sons, 2007.
3. R. E. Ireland, Organic synthesis, Prentice Hall India, Goel publishing house, 1990.
4. Clayden, Greeves, Warren, Organic Chemistry, Oxford University Press, Second Edition, 2016.
5. M. B. Smith, Organic Synthesis 3rd edn, McGraw Hill International Edition, 2011.

Reference Books

1. Gill and Wills, Pericyclic Reactions, Chapman Hall, London, 1974.

2. J.A. Joule, G.F. Smith, Heterocyclic Chemistry, Garden City Press, Great Britain, 2004.
3. W. Caruthers, Some Modern Methods of Organic Synthesis 4thedn, Cambridge University Press, Cambridge, 2007.
4. Modern Synthetic reactions, W.A. Benjamin Inc, 1972.
5. Jagdamba Singh and Jaya Singh, Photochemistry and Pericyclic Reactions, New Age International Publishers, New Delhi, 2012.

Website and e-learning source

1. https://rushim.ru/books/praktikum/Monson.pdf

Course Outcomes

Course Name: ORGANIC SYNTHESIS AND PHOTOCHEMISTRY	**Course Code: P3R3CHCC7**	**K-Level**
On Successful completion of the course, students will be able to		
CO-1	To recall the basic principles of organic chemistry and to understand the various reactions of organic compounds with reaction mechanisms.	**K4**
CO-2	To understand the versatility of various special reagents and to correlate their reactivity with various reaction conditions.	**K3**
CO-3	To implement the synthetic strategies in the preparation of various organic compounds.	**K2**
CO-4	To predict the suitability of reaction conditions in the preparation of tailor-made organic compounds.	**K3**
CO-5	To design and synthesize novel organic compounds with the methodologies learnt during the course.	**K3**

Relationship Matrix for course Outcome, Programme Outcomes and Programme Specific Outcomes

Course Name:Organic Synthesis and Photochemistry						**Course Code: P3R3CHCC7**					
	Programme Outcomes (POs)					**Programme Specific Outcomes (PSOs)**					**Mean Scores of Cos**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	3	3	3	**3.0**
CO2	2	3	3	3	2	3	3	3	3	3	**2.8**
CO3	3	3	3	2	3	3	3	3	3	3	**2.9**
CO4	3	3	3	3	3	3	3	3	3	3	**3.0**
CO5	3	2	3	3	3	3	3	3	3	3	**2.9**
Mean Overall Score											**2.92**
Mean Overall Relationship is **2.92 (HIGH)**											

Title of the Course	**COORDINATION CHEMISTRY-I**	**Marks:CIA:25+Ext:75=100**
Category of the Course:	**Core Course**	**Hrs/Week :05**
Course Code	**P3R3CHCC8**	**Total Inst. Hrs: 75**
Nature of the Course	**Skill Development**	**Sem: III Credit: 05**

Objectives: The course aims at giving an overall view of the

1. To gain insights into the modern theories of bonding in coordination compounds.
2. To learn various methods to determine the stability constants of complexes.
3. To understand and construct correlation diagrams and predict the electronic transitions that are taking place in the complexes.
4. To describe various substitution and electron transfer mechanistic pathways of reactions in complexes.
5. To evaluate the reactions of octahedral and square planar complexes.

UNITI : Modern theories of coordination compounds (15 hours)

Crystal field theory - splitting of d orbitalsin octahedral, tetrahedral and squareplanar symmetries - measurement of 10Dq - factors affecting 10Dq -spectrochemical series - crystal field stabilisation energy for high spinandlowspincomplexes-evidencesforcrystalfieldsplitting-siteselections in spinels and antispinels - Jahn Teller distortions and its consequences.Molecular OrbitalTheoryandenergyleveldiagramsconceptof Weakandstrongfields,Sigmaandpibondinginoctahedral,squareplanarand tetrahedral complexes.

Unit II Spectral characteristics of complexes (15 hours)

Term states for dions-characteristics of d-dtransitions-charge transfer spectra-selection rules for electronicspectra –Orgel correlation diagrams-Sugano-Tanabe energy level diagrams-nephelauxeticseries-Rachaparameter and calculation of inter-electronic repulsionparameter.

Unit III Stability and Magnetic property of the complexes (15hours)

Stability of complexes :Factors affecting stability of complexes, Thermodynamic aspects of complexformation, Stepwise and overall formation constants, Stability correlations, statistical factors and chelate effect, Determination of stability constant and composition of the complexes: Formation curves and Bjerrum'shalfmethod, Potentiometricmethod, Spectrophotometricmethod, Ion exchange method, Polorographic method and Continuous variation method (Job's method) Magnetic property of complexes: Spin-orbit coupling,effectofspin-orbitcouplingonmagneticmoments,quenchingof orbital magnetic moments.

Unit-IV (15 hours)

Kinetics and mechanisms of substitution reactions of octa hedral and square planar complexes:

Inert and Labile complexes ;Associative,Dissociative and SNCBmechanism pathways for substitution reactions; acid and base hydrolysis of octahedral complexes ;Classification of metal ionsbased on the rate of waterreplacement reaction and their correlation to Crystal Field ActivationEnergy ;Substitution reactions in square planar complexes :Transeffect ,theories of trans effect and applications of trans effect in synthesisof squareplanar compounds.

Unit-V: (15 hours)

Electron Transfer reactions in octahedral complexes: OutersphereelectrontransferreactionsandMarcus-Hushtheory;innersphere electron transfer reactions; nature of the bridging ligand in innersphere electron transfer reactions. Photo-redox, photo-substitution and photo-isomerisation reactionsin complexesandtheir applications.

Recommended text

1. J E Huheey, EA Keiter, RL Keiter and OK Medhi, Inorganic Chemistry – Principles of structure and reactivity, 4th Edition, Pearson Education Inc., 2006
2. G L Meissler and D ATarr, Inorganic Chemistry, 3rd Edition, Pearson Education Inc., 2008
3. D. Bannerjea, Co-ordination Chemistry, TATA Mcgraw Hill, 1993.
4. B. N. Figgis, Introduction to Ligand Fields, Wiley Eastern Ltd, 1976.
5. F. A. Cotton, G. Wilkinson.; C. A. Murillo; M. Bochmann, Advanced Inorganic Chemistry, 6th ed.; Wiley Inter-science: New York, 1988.

Reference Books

1. Keith F. Purcell and John C. Kotz, Inorganic Chemistry, Saunders Publications, USA, 1977.
2. Peter Atkins and Tina Overton, Shriver and Atkins' Inorganic Chemistry, 5th Edition, Oxford University Press, 2010
3. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson, P. L. Guas, John Wiley, 2002, 3rd edn.
4. Concepts and Models of Inorganic Chemistry, B. Douglas, D. McDaniel, J. Alexander, John Wiley, 1994, 3rd edn.
5. Inorganic Chemistry, D. F. Shriver, P. W. Atkins, W. H. Freeman and Co, London, 2010.

Web References:

https://ocw.mit.edu/courses/5-04-principles-of-inorganic-chemistry-ii-fall-2008/pages/syllabus/

Course Learning Outcomes: Students will be able:

CO1: Understand and comprehend various theories of coordination compounds.(K2)

CO2: Understand the spectroscopic and magnetic properties of coordination complexes.(K2)

CO3: Explain the stability of complexes and various experimental methods to determine the stability of complexes(.K3)

CO4: Predict the electronic transitions in a complex based on correlation diagrams and UV-visible spectral details(.K4)

CO5: Comprehend the kinetic and mechanism of substitution reactions in octahedralandsquareplanar complexes(K3).

Course Name : Coordination chemistry I						**Course Code : P3R3CHCC8**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	2	3	3	3	3	2	2	2	2	2	2.4
CO2	3	2	3	2	3	3	3	2	3	2	2.6
CO3	2	2	3	2	2	3	2	2	2	3	2.3
CO4	2	2	2	3	2	3	2	2	2	2	2.2
CO5	2	2	2	3	2	3	2	3	2	2	2.3
Mean Overall Score											**2.36**
Mean Overall Relationship is 2.36 (HIGH)											

Title of the Course :	**Physical Chemistry -II**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:	**Core course**	**Hrs/Week :05**
Course Code :	**P3R3CHCC9**	**Total Inst. Hrs: 75**
Nature of the Course :	**Skill Development**	**Sem: III Credit: 05**

Course objectives: This course aims at providing an overall view of the

1. To understand the essential characteristics of wave functions and need for the quantum mechanics.
2. To know the importance of quantum mechanical models of particle in a box, rigid rotor and harmonic oscillator.
3. To apply the quantum mechanics to hydrogen and polyelectronic systems.
4. To familiarize the symmetry in molecules and predict the point groups.
5. To predict the vibrational modes, hybridization using he concepts of group theory.

UNIT-I: . Surface Phenomena and Catalysis (16Hours)

Gibbs adsorption isotherm – solid- liquid interfaces – contact angle and wetting – solid-gas interface – physisorption and chemisorption – Langmuir, BET isotherms – surface area determination. Kinetics of surface reactions involving adsorbed species – Langmuir-Hinshelwood mechanism, Freundlich and Langmuir adsorption isotherms, absorption of solvents from solutions – applications. Role of adsorption in catalytic reaction – ion exchange adsorption – adsorption chromatography .Catalysis: Classification – characteristics of catalysis -auto catalysis – enzyme catalysis -michalis-menton equation – acid base catalysis.

UNIT-II: Electrochemistry I (15 Hours)

Electrode- Electrolyte equilibrium- Thermodynamic quantities from EMF data. Nernst equation- and its limitations- equilibrium electrode potentials- classification of electrodes - concentration cells- liquid junction potentials. Electrolytic conductance Debye-Huckel-Onsager theory – Debye Falkenhagen and Wien effect. -Electrode – electrolyte equilibrium, electrode potential – concentration cells. Processes at Electrodes- The rate of charge transfer - current density – Electokinetic phenomena: - electro osmosis-electrophopreseis- sedimentation potential - Theories of electrical double layer-Electrical double layer potential -zeta potential- theory of multiple layers at electrode electrolyte interface- double layer capacity- Butler – Volmer Equation – Tafel equation –, Applications: Fuel cells and power storage

UNIT-III: Basic concepts of Quantum mechanics (15Hours)

Classical mechanics – #General principles, basic assumptions, postulates of classical mechanics, conservation laws, Lagrange's and Hamilton's equations of Motion (no derivation).Wave particle dualism – uncertainty principles – functionsorthogonality and Normalisation - operator - operator algebra. Linear and Hermitian - eigen function and eigen values. Angular momentum operator--commutation relations. Postulates of quantum mechanics – Solving the Schrodinger wave equation (SWE) to simple systems viz., particle in a box – one and three dimensional, (1D and 3D box)

UNIT-IV: Applications of Quantum Mechanics (15Hours)

Setting and solving Schrodinger wave equation for harmonic oscillator, rigid-rotator, hydrogen and hydrogen like atoms (He^+ and Li^{2+}). Shapes of atomic orbitals - radial and angular probability distribution functions. Approximation methods – linear variation principle, application to hydrogen and helium atoms, perturbation method for non-degenerate systems, application of perturbation theory to helium atom. Pauli's principle and Slater determinants – variation method – application of perturbation theory to helium atom. Hertree – Forkself consistent field method. L – S and J – J coupling.

Born – Openheimer approximation: Hydrogen molecule ion. LCAO method. MO and VB treatments of the hydrogen molecule. Hybridization and molecular orbitals of H_2O, NH_3 and CH_4.Huckel pi-electron method for butadiene and benzene

UNIT-V: Concepts of Group Theory (14Hours)

Elements of group theory – definition – group multiplication tables for C_2V and C_3V point groups – conjugate classes, conjugate and normal subgroups – symmetry elements and operations – point groups – assignment of point groups to molecules, - Matrix representation of geometric transformation and point groups – reducible and irreducible representations– Great Orthogonality Theorm -properties of irreducible representation – construction of character tables – C_2V, C_3V, C_2h.

Text Books

1. R.K. Prasad, Quantum Chemistry, New Age International Publishers, New Delhi, 2010, 4th revised edition.
2. F. A. Cotton, Chemical Applications of Group Theory, John Wiley & Sons, 2003, 2nd edition.
3. A. Vincent, Molecular Symmetry and Group Theory. A Programmed Introduction to Chemical Applications, John and Willy & Sons Ltd., 2013, 2nd Edition.

4. T. Engel & Philip Reid, Quantum Chemistry and Spectroscopy, Pearson, New Delhi, 2018, 4th edition.
5. G. K. Vemulapalli, Physical Chemistry, Prentice Hall of India Pvt. Ltd. 2001. 6. D.A. McQuarrie, Quantum Chemistry, Viva Books PW. Ltd, 2013, 2nd edition.

Reference Books

1. N. Levine, Quantum Chemistry, Allyn& Bacon Inc, 1983, 4th edition.
2. D.A. McQuarrie and J. D. Simon, Physical Chemistry, A Molecular Approach, Viva Books Pvt. Ltd, New Delhi, 2012.
3. R. P. Rastogi & V. K. Srivastava, An Introduction to Quantum Mechanics of Chemical Systems, Oxford & IBH Publishing Co., New Delhi, 1999.
4. R.L. Flurry. Jr, Symmetry Group Theory and Chemical applications, Prentice Hall. Inc, 1980
5. J.. Hollas, Symmetry in Molecules, Chapman and Hall, London, 2011, Reprint.

Website and e-learning source

1. https://nptel.ac.in/courses/104101124
2. https://ipc.iisc.ac.in/~kls/teaching.html

Course Learning Outcomes: Students will be able:
CO1: To discuss the characteristics of wave functions and symmetry functions. (K3)
CO2: To classify the symmetry operation and wave equations. (K4)
CO3: To apply the concept of quantum mechanics and group theory to predict the electronic structure. (K2)
CO4: To specify the appropriate irreducible representations for theoretical applications. (k4)
CO5: To develop skills in evaluating the energies of molecular spectra. (K4)

Relationship Matrix for course Outcome, Programme Outcomes and Programme Specific Outcomes

Course Name:Physical chemistry II						**Course Code: P3R3CHCC9**					
	Programme Outcomes (POs)					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	3	3	3	**3.0**
CO2	2	3	3	3	2	3	3	3	3	3	**2.8**
CO3	3	3	3	2	3	3	3	3	3	3	**2.9**

CO4	3	3	3	3	3	3	3	3	3	3	**3.0**
CO5	3	2	3	3	3	3	3	3	3	3	**2.9**
Mean Overall Score											**2.92**
Mean Overall Relationship is **2.92 (HIGH)**											

Title of the Course :	**Physical Chemistry Practical**	**Marks: CIA:40 + Ext:60=100**
Category of the Course :	**Core Course**	**Hrs/Week :05**
Course Code :	**P3R3CHCC10P**	**Total Inst. Hrs: 75**
Nature of the Course :	**Skill Development**	**Sem:III Credit: 5**

Objectives: To make students understand

1. To understand the principle of conductivity experiments through conductometric titrations.
2. To evaluate the order of the reaction, temperature coefficient, and activation energy of the reaction by following pseudo first order kinetics.
3. To construct the phase diagram of two component system forming congruent melting solid and find its eutectic temperatures and compositions.
4. To determine the kinetics of adsorption of oxalic acid on charcoal.
5. To Verification the Kohlrausch's Law

EXPERIMENTS

1. Determination of the equivalent conductance of a weak acid at different concentrations and verifying Ostwald dilution law. Calculation of the dissociation constant of the acid.
2. Conductometric titration of a mixture of HCl and CH_3COOH Vs NaOH.
3. Conductometric titration of NH_4Cl Vs NaOH.
4. Conductometric titration of CH_3COONa Vs HCl.
5. Potentiometric titration of a mixture of HCl and CH_3COOH Vs NaOH
6. Potentiometric titration of FAS Vs $K_2Cr_2O_7$
7. Potentiometric titration of KI Vs $KMnO_4$.
8. Potentiometric titration of a mixture of Chloride and Iodide Vs $AgNO_3$.
9. Determination of equivalent conductance of a strong electrolyte & the verification of DHO equation.
10. Verification of Kohlrausch's Law for weak electrolytes.
11. 4. Determination of solubility of a sparingly soluble salt.
12. 5. Acid-base titration (strong acid and weak acid vs NaOH).

13. 6. Precipitation titrations (mixture of halides only).
14. Study the kinetics of acid hydrolysis of an ester, determine the temperature coefficient and also the activation energy of the reaction.
15. Construction of phase diagram for a simple binary system
    a). Naphthalene-biphenyl
    b)Benzophenone- diphenyl amine
16. Adsorption of oxalic acid on charcoal & determination of surface area (Freundlich isotherm only.

Text Book

1. B. Viswanathan and P.S.Raghavan, Practical Physical Chemistry, Viva Books, New Delhi, 2009.
2. Sundaram, Krishnan, Raghavan, Practical Chemistry (Part II), S. Viswanathan Co. Pvt., 1996.
3. V.D. Athawale and Parul Mathur, Experimental Physical Chemistry, New Age International (P) Ltd., New Delhi, 2008.
4. E.G. Lewers, Computational Chemistry: Introduction to the Theory
5. and Applications of Molecular and Quantum Mechanics, 2nd Ed.,
6. Springer, New York, 2011.

Reference Books

1. J. B. Yadav, Advanced Practical Physical Chemistry, Goel Publishing House, 2001.
2. G.W. Garland, J.W. Nibler, D.P. Shoemaker, Experiments in Physical Chemistry, 8th edition, McGraw Hill, 2009.
3. J. N. Gurthu and R. Kapoor, Advanced Experimental Chemistry, S. Chand and Co., 1987.
4. Shailendra K Sinha, Physical Chemistry: A laboratory Manual, Narosa Publishing House Pvt, Ltd., New Delhi, 2014

CO No.	CO-Statements	K-Level
On Successful completion of the course, students will be able to		
CO-1	To recall the principles associated with various physical chemistry experiments.	**K5**
CO-2	To scientifically plan and perform all the experiments.	**K4**
CO-3	To observe and record systematically the readings in all the experiments	**K3**
CO-4	To calculate and process the experimentally measured values and compare with graphical data	**K4**
CO-5	To interpret the experimental data scientifically to improve students' efficiency for societal development	**K4**

Relationship Matrix for course Outcome, Programme Outcomes and Programme Specific Outcomes

Title of the Course: PHYSICAL CHEMISTRY PRACTICAL						Course Code: P3R3CHCC10P					
Course Outcomes (Cos)	Programme Outcomes(POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2	3	2	2	3	3	2	2	3	2.3
CO2	3	3	1	3	2	3	2	3	3	3	2.6
CO3	2	1	3	2	2	3	2	2	3	3	2.3
CO4	3	2	1	2	2	3	3	3	3	3	2.5
CO5	3	1	2	3	3	3	3	2	3	3	2.6
	Mean Overall Score										2.46
	Result										High

Title of the Course :	**Chemistry of Natural Products**	**Marks: CIA:25 + Ext:75=100**
Category of the Course :	**Discipline Specific Elective**	**Hrs/Week :05**
Course Code :	**P3R3CHDSE5:1**	**Total Inst. Hrs: 75**
Nature of the Course :	**Skill Development**	**Sem: III Credit: 3**

Objectives: To make students understand

1. To learn the basic concepts and biological importance of biomolecules and natural products.
2. To explain various of functions of carbohydrates, proteins, nucleic acids, steroids and hormones.
3. To understand the functions of alkaloids and terpenoids.
4. To elucidate the structure determination of biomolecules and natural products.
5. To extract and construct the structure of new alkaloids and terpenoids from different methods

Unit-I: A**lkaloids:** Introduction, occurrence, classification, isolation and functions ofalkaloids. Classification, general methods of structurale lucidation. Chemical methods of structure determination of Coniine, Piperine, Nicotine, Papaverine., Quinine, , Cocaine and Morphine.

Unit-II:Terpenoids and Carotenoids: Terpenoids: Introduction, occurrence, Isoprene rule,classification. General methods of determiningstructure.. Structure determination of

Camphor, Abietic acid,Squalene, Zingiberine.**Carotenoids:** Introduction, geometricalisomerism, Structure, functions and synthesis of β-carotene andvitamin-A

Unit III: Anthocyanines and flavones: Anthocyanines: Introduction toanthocyanines.Structure and general methods of synthesis ofanthocyanines. Cyanidine chloride: structure anddetermination.**Flavones**: Biological importance of flavones. Structure and determination of flavone andflavonoids. Quercetin: Structure determination andimportance

Unit-IV:Purines and Steroids: Purines: Introduction, occurrence and isolation of purines. Classification and. biological importance, Structure and synthesis of Caffeine. **Steroids**: Steroids-Introduction, occurrence,configuration of substituents, Diels' hydrocarbon, , classification, biological importance, colour reactions of sterols, cholesterol-occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene.

Unit V : Natural dyes: Occurrence, classification, isolation, purification, properties, colour and constitution. Structural determination and synthesis of indigotin and alizarin.

Text Books

1. T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH,North America,2007.
2. I. L. Finar, Organic Chemistry Vol-2, 5th edition,PearsonEducation Asia, 1975.
3. V. K. Ahluwalia and M. Goyal, Textbook of Heterocyclic compounds,Narosa Publishing, New Delhi,2000.
4. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014.

Reference Books

1. I. L. Finar, Organic Chemistry Vol-1, 6th edition, Pearson Education Asia,2004.
2. Pelletier, Chemistry of Alkaloids, Van NostrandReinhold Co,2000.
3. Shoppe, Chemistry of the steroids, Butterworthes,1994.

CO No.	CO-Statements	K-Level
On Successful completion of the course, students will be able to		
CO-1	understand the biological importance of chemistry of natural product	**K2**
CO-2	scientifically plan and perform the isolation and characterization of synthesized natural products.	**K3**
CO-3	elucidate the structure of alkaloids, terpenoids, carotenoids, falvanoids and anthocyanins.	**K3**
CO-4	determine the structure of phytochemical constituents by chemical and physical methods.	**K5**
CO-5	interpret the experimental data scientifically to improve biological activity of active components.	**K4**

Relationship Matrix for course Outcome, Programme Outcomes and Programme Specific Outcomes

Title of the Course: CHEMISTRY OF NATURAL PRODUCTS						Course Code: P3R3CHDSE5:1					
Course Outcomes (Cos)	Programme Outcomes(POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2	3	2	2	3	3	2	2	3	2.3
CO2	3	3	1	3	2	3	2	3	3	3	2.6
CO3	2	1	3	2	2	3	2	2	3	3	2.3
CO4	3	2	1	2	2	3	3	3	3	3	2.5
CO5	3	1	2	3	3	3	3	2	3	3	2.6
	Mean Overall Score										2.46
	Result										High

Title of the Course :	Pharmacognosy and Phytochemistry	Marks: CIA:25 + Ext:75=100
Category of the Course:	Discipline Specific Elective	Hrs/Week :05
Course Code :	P3R3CHDSE5:2	Total Inst. Hrs: 75
Nature of the Course :	Skill Development	Sem: III Credit: 03

Course objectives: This course aims at providing an overall view of the

1. To develop the knowledge of natural products, biological functions and pharmacological uses.
2. To develop knowledge on primary and secondary metabolites and their sources.
3. To understand the concepts of isolation methods and separation of bioactive compounds.
4. To provide the knowledge on selected glycosides and marine drugs.
5. To familiarize the guidelines of WHO and different sampling techniques.

UNIT-I: Pharmacognosy and Standardization of Herbal drugs (15 Hours)

Introduction, definition, development classification and Source of Drugs: Biological, mineral, marine,and plant tissue cultures. Study of pharmacognostic of a crude drug. Biosynthesis: Shikimic acid pathway and acetate pathway. Systematic analysis of Crude drugs. Standardization of Herbal drugs. WHO guidelines, Sampling of crude drug, Methods of drug evaluation. Determination of foreign matter, moisture Ash value. Phytochemical investigations- General chemical tests.

UNIT-II: Extraction Techniques (15 Hours)

General methods of extraction, types – maceration, Decoction, percolation, Immersion and soxhlet extraction. Advanced techniques- counter current, steam distillation, supercritical gases, sonication, Micro waves assisted extraction. Factors affecting the choice of extraction process.

UNIT-III: Drugs containing Terpenoids and volatile oils (15 Hours)

Terpenoids: Classification, Isoprene rule, Isolation and separation techniques, General properties Camphor, Menthol, Eucalyptol. Volatile Oils or Essential Oils: Method of Preparations, Classifications of Volatile oils, Camphor oil, Geranium oil, Citral- Structure uses. Pentacyclic triterpenoids: amyrines; taraxasterol: Structure and pharmacological applications.

UNIT-IV: Drugs containing alkaloids (15 Hours)

Occurrence, function of alkaloids in plants, pharmaceutical applications. Isolation, Preliminary Qualitative tests and general properties. General methods of structural elucidation. Morphine, Reserpine, papaverine - chemical properties, structure and uses. papaverine - structure, chemical properties and uses.

UNIT-V: Plant Glycosides and Marine drugs (15 Hours)

Glycosides: Basic ring system, classification, isolation, properties, qualitative analysis. Pharmacological activity of Senna glycosides, Cardiac glycosides-Digoxin, digitoxin, Steroidal saponins glycosides- Diosgenin, hecogenin. Plant pigments: Occurrence and general methods of structure determination, isolation and synthesis of quercetin and cyanidin chloride. Marine drugs -Selected Drug Molecules: Cardiovascular active substances, Cytotoxic compounds, antimicrobial compounds, antibiotic compounds, Anti-inflammatory agents. Marine toxins.

Text Books

1. Gurdeep R Chatwal (2016), Organic chemistry of Natural products, Volume I&II, 5th edition, Himalaya publishing House.
2. S.V.Bhat, B.A. Nagasampagi, M.Sivakumar (2014), Chemistry of Natural Products, Revised edition, Narosa Publishers.

Reference Books

1. Jeffrey B. Harborne (2012), Phytochemical methods: A Guide to Modern Techniques of Plant Analysis, 4th edition, Indian reprint, Springer.
2. Ashutoshkar (2007), Pharmacognosy and Pharmacobiotechnology, 2 nd edition, New age international (P) limited, New Delhi

Course Outcomes

Course Name: PHARMACOGNOSY AND PHYTOCHEMISTRY	**Course Code: P3R3CHDSE5:2**	**K-Level**
On Successful completion of the course, students will be able to		
CO-1	To recall the sources of natural medicines and analysis of crude drugs.	**K3**
CO-2	To understand the methods of evaluation based on various parameters.	**K4**
CO-3	To analyze the isolated drugs	**K3**
CO-4	To apply various techniques to discover new alternative medicines.	**K2**
CO-5	To evaluate the isolated drugs for various pharmacological activities	**K3**

Relationship Matrix for course Outcome, Programme Outcomes and Programme Specific Outcomes

Course Name: Pharmacognosy and Phytochemistry	**Course Code: P3R3CHDSE5:2**

	Programme Outcomes (POs)					Programme Specific Outcomes (PSOs)					Mean Scores of COs
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	3	3	3	**3.0**
CO2	2	3	3	3	2	3	3	3	3	3	**2.8**
CO3	3	3	3	2	3	3	3	3	3	3	**2.9**
CO4	3	3	3	3	3	3	3	3	3	3	**3.0**
CO5	3	2	3	3	3	3	3	3	3	3	**2.9**
Mean Overall Score											**2.92**
Mean Overall Relationship is **2.92 (HIGH)**											

Title of the Course	**:**	**Polymer Chemistry**	**Marks: CIA:25 + Ext:75=100**
Category of the Course:		**Skill Enhancement Course**	**Hrs/Week :05**
Course Code	**:**	**P3R3CHSEC2:1**	**Total Inst. Hrs: 75**
Nature of the Course	**:**	**Skill Development**	**Sem: III Credit: 02**

Objectives of the course To learn the basic concepts and bonding in polymers.

1. To explain various types of polymerization reactions and kinetics.
2. To understand the importance of industrial polymers and their synthetic uses.
3. To determine the molecular weight of polymers.
4. To predict the degradation of polymers and conductivities.
5. To apply polymer processing and technique.

UNIT-I: Molecular Weight and it's Determination: (18 Hours)

Determination of Molecular mass of polymers: Number Average molecular mass (Mn) and Weight average molecular mass (Mw) of polymers. Molecular weight determination of high polymers by physical and methods.

UNIT-II: Mechanism and kinetics of Polymerization:. (12Hours)

Chain growth polymerization: Cationic, anionic, free radical polymerization, Stereo regular polymers: Ziegler Natta polymerization. Reaction kinetics. Step growth polymerization, Degree of polymerization.

UNIT-III: Techniques of Polymerization and Polymer Degradation:. (15 Hours)

Bulk, Solution, Emulsion, Suspension, solid, interfacial and gas phase polymerization. Types of Polymer Degradation, Thermal degradation, mechanical degradation, photodegradation, Photo stabilizers, Solid and gas phase polymerization.

UNIT-IV: Industrial Polymers:. (18 Hours)

Thermoplastics: Polyethylene, Polypropylene, polystyrene, Polyacrylonitrile, Poly Vinyl Chloride, Poly tetrafluoro ethylene, nylon and polyester. Thermosetting Plastics: Phenol formaldehyde and expoxide resin. Elastomers: Natural rubber and synthetic rubber - Buna - N, Buna-S and neoprene.

UNIT-V: Processing Techniques:. **(12 Hours)**

Calendaring, die casting, compression moulding, injection moulding, blow moulding and reinforcing. Film casting, Thermofoaming, Foaming. Catalysis and catalysts – Polymerization catalysis.

Text Books

1. V.R. Gowariker, Polymer Science, Wiley Eastern, 1995.
2. G.S. Misra, Introductory Polymer Chemistry, New Age International (Pvt) Limited, 1996.
3. M.S. Bhatnagar, A Text Book of Polymers, vol-I & II, S.Chand & Company, New Delhi, 2004.

Reference Books

1. F. N. Billmeyer, Textbook of Polymer Science, Wiley Interscience, 1971.
2. A. Kumar and S. K. Gupta, Fundamentals and Polymer Science and Engineering, Tata McGraw-Hill, 1978.

Course Learning Outcomes (for Mapping with POs and PSOs)

Students will be able:

CO1: To understand the bonding in polymers.(K3)
CO2: To scientifically plan and perform the various polymerization reactions.(K4)
CO3: To observe and record the processing of polymers.(K4)
CO4: To calculate the molecular weight by physical and chemical methods(K3).
CO5: To interpret the experimental data scientifically to improve the quality of synthetic polymers.(K2)

Relationship Matrix for course Outcome, Programme Outcomes and Programme Specific Outcomes

Course Name: POLYMER CHEMISTRY						**Course Code: P3R3CHSEC2:1**					
	Programme Outcomes (POs)					**Programme Specific Outcomes (PSOs)**					**Mean Scores of COs**
Course Outcomes (COs)	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	3	3	3	3	**3.0**
CO2	2	3	3	3	2	3	3	3	3	3	**2.8**
CO3	3	3	3	2	3	3	3	3	3	3	**2.9**
CO4	3	3	3	3	3	3	3	3	3	3	**3.0**
CO5	3	2	3	3	3	3	3	3	3	3	**2.9**
Mean Overall Score											**2.92**
Mean Overall Relationship is **2.92 (HIGH)**											

Title of the course	**:**	**Biomolecules sand heterocyclic compounds**	**Marks: CIA:25 + Ext:75=100**
Category of the Course	**:**	**Skill Enhancement Course**	**Hrs/Week :05**
Course Code	**:**	**P3R3CHSEC2:2**	**Total Inst. Hrs: 75**
Nature of the Course	**:**	**Skill Development**	**Sem:III Credit: 02**

Objectives:

1. To learn the basic concepts and biological importance of biomolecules and natural products.
2. To explain various of functions of carbohydrates, proteins, nucleic acids, steroids and hormones.
3. To understand the functions of alkaloids and terpenoids.
4. To elucidate the structure determination of biomolecules and natural products.
5. To extract and construct the structure of new alkaloids and terpenoids from different methods.

UNIT-I: Chemistry and metabolism of carbohydrates: Definition, classification and biological role of carbohydrates. monosaccharides: Linear and ring structures (Haworth formula) of ribose, glucose, fructose (structure determination not required), physical and chemical properties of glucose and fructose.Disaccharides: Ring structures (Haworth formula) – occurrence, physical and chemical properties of maltose, lactose and sucrose.

UNIT-II:Steroids and Hormones: Steroids-Introduction, occurrence, nomenclature, configuration of substituents. Diels' hydrocarbon, stereochemistry, classification, Diels' hydrocarbon, biological importance, colour reactions of sterols, cholesterol-occurrence, tests, physiological activity, biosynthesis of cholesterol from squalene. **Hormones-**Introduction, classification, functions of sex hormones- androgens and estrogens, adrenocortical hormones-cortisone andcortisol structure and function's of non-steroidal hormones-adrenaline and thyroxin

UNIT-III :Proteins andnucleicacids: Separation and purification of proteins – dialysis, gel filtration and electrophoresis. Catabolism of amino acids - transamination, oxidative deamination and decarboxylation. Biosynthesis of proteins: Role of nucleic acids. Amino acid metabolism and Primary and secondary structure of RNA and DNA, Watson-Crick model, solid phasesynthesis of oligonucleotides

UNIT-IV: Fused Ring Heterocyclic Compounds I: Benzofused five membered rings: Indole, isoindole, benzofuran and benzothiophene, Preparation and properties. Benzofused six membered rings: Quinoline and isoquinoline: Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilicsubstitutions, oxidation reduction reactions

UNIT-V: Fused Ring Heterocyclic Compounds II: Sixmembered rings: Quinoline and isoquinoline: Preparation by ring closure reactions, Reactions: Mechanism of electrophilic and nucleophilicsubstitutions, oxidation reduction reactions

Text Books

1. T. K Lindhorst, Essentials of Carbohydrate Chemistry and Biochemistry, Wiley VCH,North America,2007.
2. I. L. Finar, Organic Chemistry Vol-2, 5th edition,PearsonEducation Asia, 1975.
3. V. K. Ahluwalia and M. Goyal, Textbook of Heterocyclic compounds,Narosa Publishing, New Delhi,2000.
4. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., Jalandhar, Delhi, 2014.
5. V. K. Ahluwalia, Steroids and Hormones, Ane books pub., New Delhi,2009.

Reference Books

1. L. Finar, Organic Chemistry Vol-1, 6thedition, Pearson Education Asia,2004
2. .Pelletier, Chemistry of Alkaloids, Van NostrandReinhold Co,2000.
3. Shoppe, Chemistry of the steroids, Butterworthes,1994.
4. I. A. Khan, and A. Khanum. Role of Biotechnology in medicinal & aromatic plants, Vol 1 and Vol 10, Ukkaz Publications, Hyderabad,2004.

CO No.	CO-Statements	K-Level
On Successful completion of the course, students will be able to		
CO-1	learn about in biological importance of biomelecules and natural products	K2
CO-2	Learn about the functions of biomelecules	K3
CO-3	Learn about the structural determination of natural products	K3
CO-4	Understand the important function of alkaloids and Terpenoids	K4
CO-5	Predict the new structure of natural products	K4

Relationship Matrix for course Outcome, Programme Outcomes and Programme Specific Outcomes

Title of the Course: BIOMOLECULES AND HETEROCYCLIC COMPOUNDS						Course Code:P3R3CHSEC2:2					
Course Outcomes (Cos)	Programme Outcomes(POs)					Programme Specific Outcomes (PSOs)					Mean Score of Cos
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	1	2	3	2	2	3	3	2	2	3	2.3
CO2	3	3	1	3	2	3	2	3	3	3	2.6
CO3	2	1	3	2	2	3	2	2	3	3	2.3
CO4	3	2	1	2	2	3	3	3	3	3	2.5
CO5	3	1	2	3	3	3	3	2	3	3	2.6
	Mean Overall Score										2.46
	Result										High

Title of the Course	**COORDINATION CHEMISTRY-II**	**Marks: CIA:25 + Ext:75=100**
Category of the Course	**Core Course**	**Hrs/Week :06**
Course Code	**P4R3CHCC11**	**Total Inst. Hrs: 80**
Nature of the Course	**Skill Development**	**Sem: IV Credit: 05**

Objectives: The course aims at giving an overall view of the

1. To recognize the fundamental concept sand structural aspects of organometallic compounds
2. To learn reactions of organometallic compounds and their catalytic behaviour.
3. To identify or predict the structure of coordination compounds using spectroscopic tools.
4. To understand the structure and bonding in coordination complexes.
5. To evaluate the spectral characteristics of selected complexes.

UNITI: Chemistry of organometallic compounds (16 hours)

Classification of organometallic compounds based on M-C bond – 18 and 16 electronrule; Bonding in metal –olefin complexes (example:Ziese'ssalt) ,metal –acetylene and metal-allyl complexes ;Metal-cyclopentadienyl complexes – Examples and MO approach to bonding in metallocenes. Metal – carbonyl complexes: MO diagram of CO ;Structure and bonding – bonding modes ,MO approach of M-CO bonding ,π-accep to rnature of carbony lgroup, synergistic effect (stabilization of lower oxidation states of metals); Carbonyl clusters: Low nuclearity and high nuclearity carbonylclusters –Structures based on poly hedral skeleton lectronpair theory or Wade'srule.

Unit II: Reactions and catalysis of organometallic compounds (16 hours)

Reactions of organometallic compounds: Oxidative addition, reductive elimination (α and βeliminations), migratory insertion reaction and metathesisreaction. Organo-metallic catalysis :Hydrogenation of olefins (Wilkinson's catalyst), hydroformylation of olefins using cobalt or rhodium catalysts (oxoprocess) ,oxidation of olefin (Wackerprocess), olefinisomerisation, watergas shift reaction, cyclo- oligomerisation of acetyl enesusingReppe'scatalysts ,Monsontoprocess.

Unit III :Inorganicspectroscopy–I (16 hours)

IRspectroscopy: Effect of coordination o n the stretching frequency-sulphato, carbonato, sulphito,aqua,nitro,thiocyanato,cyano,thiourea,DMSOcomplexes;IRspectroscopyofcarbonylcompounds.NMRspectroscopy-Introduction, applications of 1H, 15N, 19F, 31P-NMR

spectroscopy in structural identification of inorganic complexes, fluxionalmolecules, quadrupolarnuclei-effect in NMR spectroscopy.

Unit-IV: Inorganic spectroscopy-II (16 hours)

Introductory terminologies: gand A parameters-definition, explanation and factors affecting g and A;Applications of ESR to coordination compounds with one and more than one unpaired electrons hyperfine and secondary hyperfine splitting and Kramer'sdoublets ;ESR spectra of V(II), Mn(II) ,Fe(II), Co(II), Ni(II), Cu(II) complexes ,bis(salicylaldimine)copper(II) **Mossbauerspectroscopy**: Mossbauereffect ,Recoilenergy ,Mossbauer active nuclei ,Dopplershift ,Isomer shift,quadrupole splitting and magnetic interactions. Applicationso fMössbauerspectra to Fe and Sn compounds.

Unit-V: : Photo Electron Spectroscopy (16hours)

Theory, Types, origin of fine structures - shapes of vibrational fine structures – adiabatic and vertical transitions, PES of homo nuclear diatomicmolecules (N_2,O_2)and heteronuclear diatomicmolecules (CO,HCl)and polyatomicmolecules (H_2O, CO_2, CH_4, NH_3) – evaluation of vibrational constants of the above molecules .Koopman'stheorem- applications and limitations. Optical Rotatory Dispersion – Principle of CD and ORD; Δ and λ isomer sin complexes ,Assignment of absolute configuration using CD and ORD techniques.

Recommended text

1. JEHuheey,EAKeiter,RLKeiterandOKMedhi,InorganicChemistry– Principlesofstructureandreactivity,4thEdition,PearsonEducationInc.,2006
2. GLMeisslerandDATarr,InorganicChemistry,3rdEdition,PearsonEducationInc.,2008
3. D.Bannerjea,Co-ordinationChemistry,TATAMcgrawHill,1993.
4. BDGuptaandAKElias,BasicOrganometallicChemistry:Concepts,SynthesesandApplications , UniversityPress, 2013.
5. F.A.Cotton,G.Wilkinson.;C.A.Murillo;M.Bochmann, AdvancedInorganicChemistry,6thed.;WileyInter-science:NewYork,1988.

Reference Books

1. Crabtree, Robert H. The Organometallic Chemistry of the TransitionMetals.3rd ed. New York, NY: JohnWiley, 2000.
2. PGütlich,EBill,AXTrautwein,MossbauerSpectroscopyandTransitionMetalChemistry:Fundamentalsand Applications,1st edition,Springer-VerlagBerlin Heidelberg, 2011.
3. Concepts and Models of Inorganic Chemistry,B.Douglas,D.McDaniel, J.Alexander,John Wiley,1994,3rdedn.
4. K.F.Purcell,J.C.Kotz,InorganicChemistry;Saunders:Philadelphia,1976.
5. R.S.Drago,PhysicaIMethodsinChemistry;Saunders:Philadelphia,1977.

Web References:

https://archive.nptel.ac.in/courses/104/101/104101100/

CourseLearningOutcomes (forMappingwithPOsand PSOs)

Studentswill beable:

CO1:Understand and apply18 and16 electron rule for organometallic compounds(K2)

CO2:Understand the structure and bonding in olefin, allyl ,cyclopentadienyl and carbonyl containing organometallic compounds(K2)

CO3:Understand the reactions of organometallic compounds and a catalytic cycles(K2)

CO4: Identify / predict the structure of coordination complexes using spectroscopic tool such as IR, NMR, ESR, Mossbauer and optical rotatory dispersion studies(K4)

CO5: To interpret the structureof molecules by various spectral techniques.(K1)

Course Name : Coordination chemistry II						**Course Code : P4R3CHCC11**					
Course Outcomes (COs)	**Programme Outcomes (POs)**					**Programme Specific Outcomes (PSOs)**					**Mean Score of COs**
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PSO1**	**PSO2**	**PSO3**	**PSO4**	**PSO5**	
CO1	3	3	3	3	3	3	2	2	2	2	2.7
CO2	3	2	3	2	3	2	3	2	3	2	2.5
CO3	2	2	3	2	2	3	2	2	2	3	2.3
CO4	2	2	2	3	2	3	2	2	2	2	2.2
CO5	2	2	2	3	2	3	2	3	2	3	2.4
Mean Overall Score											**2.42**
Mean Overall Relationship is 2.36 (HIGH)											

TITLE OF THE COURSE	**ANALITICAL CHEMISTRY**	**MARKS:CIA:25 + EXT:75=100**
CATEGORY OF THE COURSE	**CORE COURSE**	**HRS/WEEK : 6**
COURSE CODE	**P4R3CHCC12**	**TOTAL INST. HRS : 80**
NATURE OF THE COURSE	**SKILL DEVELOPMENT**	**SEME : IV / CRIDIT : 5**

Objectives

1. To understand the Instrumental methods of various spectroscopy
2. To acquire skill of calculation of analytical data
3. To understand the electroanalytical techniques and thermo analytical methods in analytical techniques
4. To determine the accuracy.
5. To analyse the chromatographic methods.

UNIT-II: Data and Error Analysis (UNIT 1) (15 Hrs)

Various types of Error–Accuracy, precision, significant figures–Frequency distributions, the binomial distribution, the Poisson distribution and normal distribution–Describing data, population and sample, mean, variance, standard deviation, way of quoting uncertainty, robust estimators, repeatability and reproducibility of measurements–Hypothesis testing, levels of confidence and significance, test for an outlier, testing variances, means t-Test, Paired t-Test..Analysis of variance (ANOVA) – Correlation and Regression – Curve fitting , Fitting of linear equations, simple linear cases, weighted linear case, analysis of residuals – General polynomial equation fitting , linearizing transformations, exponential function fit–r and its abuse – multiple linear regression analysis, elementary aspects.

UNIT-III: Chromatography (15 Hrs)

Solvent extraction – principles of ion exchange, paper, thin layer and column Chromatography techniques– Columns, adsorbents, methods, Rf values, McReynold's constants and their uses. HPTLC, HPLC techniques – Adsorbents, columns, detection methods, estimations, preparative column – GC-MS techni**ques: methods, principles and uses.**

UNIT-IV: Thermo Analytical Methods (15 Hrs) Principles-factors affecting thermogram, instrumentation and thermal decomposition ofCaC2O4.H2O and CuSO4.5H2O. Differential technique:Instrumentation,experimental,instrumental factors of DTA and DSC. Thermal studies of CuSO4.5H2O by DTA and determination of purity of pharmaceuticals and phase transition studies by DSC – evaluation and thermodynamic parameters.. Electrogavimetry:Principle,instrumentation, deposition and separation. Electrolysis at constant. Thermometric titrations.

UNIT-IV: Electro Analytical Techniques (15 Hrs)

Electrochemical sensors- ion sensitive electrodes, glass – membrane electrodes, solid liquid membrane electrodes – ion-selective field effect transistors (ISFETs) – Sensors for the analysis

of gases. Amperometric titrations: Principles- Apparatus –techniques – applications. Polarography- principles & instrumentation-Principles of Cyclic voltammetry-instrumentation of cyclic voltammetry-applications.

UNIT-V: Instrumental methods of Analysis (15 Hrs)

Principles and Applications of Atomic Absorption Spectroscopy (AAS)-Flame Emission Spectroscopy (FES)-Extended X-ray absorption fine structure (EXAFS)– Surface extended X-ray absorption (SEXAFS).s

References Books

1. Analysis for chemistry, Oxford University Press, 2006.
2. J. Topping, Errors of Observation and their treatment, 4th Ed., Chapman Hall, London, 1984.
3. .R. Stock and C. B. F. Rice, Chromatographic Methods, Chapman and Hall, New York.
4. V.K. Srivastava and K.K. Srivastava, Introduction to Chromatography, S. Chand & Co., New Delhi, 2nd Ed,1981.
5. Willard, Merrit, Dean and Settle, Instrumental methods of Analysis CBS Publishers and Distributors, 6th Ed., 1986.
6. D. A. Skoog, D.M.West, F.J. Holler, F. J., Fundamentals of Analytical Chemistry, 7th Ed., Harcourt College Publishers, Singapore.
7. .A.Sharma, S.G. Schulman, Introduction to Fluoresceence Spectroscopy, WileyInterscience.New York,1999.
8. C.N.Banwell and E.M.McCash, Fundamentals of Molecular spectroscopy, 4th Ed., TataMcGraw-Hill, New Delhi, 1994.
9. Vogel, A. I., Text book of Quantitative Inorganic Analysis, ELBS.
10. .Daniel C Harris, Quantitative Chemical Analysis, 4th Ed., W. H. Freeman and Company, New York, 1995.
11. S.C.Gupta, Fundamentals of Statistics,6th Ed., Himalaya Publ. House, Delhi, 2006.

Course Outcomes: At the end of the course, the learners will be able to

CO.No	***CO-statements***	**(k - level)**
On successful completion of the course ,students will be able to		
CO-1	Understand the accuracy, precision and errors	***K5***
CO-2	Know the solvent extraction and recrystallization techniques	***K3***
CO-3	Understand the principle, instrumentation, working and uses of various chromatography technique	***K4***
CO-4	.Understand the principle, instrumentation, working of thermal analytical methods.	***K5***
CO-5	Know the basic concepts of electro analytical technique	***K5***

Relationship Matrix for course Outcome, Programme Outcomes and Programme Specific Outcomes

TITLE OF THE COURSE: ANALITICAL CHEMISTRY						COURSE CODE: P4R3CHCC12					
COURSE OUTCOMES (COS)	PROGRAMME OUTCOMES(POS)					PROGRAMME SPECIFIC OUTCOMES (PSOS)					MEAN SCORE OF COS
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5	
CO1	3	2	3	2	3	2	3	2	3	3	2.6
CO2	2	3	2	2	3	2	3	2	3	1	2.3
CO3	1	2	2	2	3	3	2	2	2	3	2.2
CO4	2	3	1	3	3	2	2	3	2	3	2.4
CO5	2	2	3	3	2	2	3	2	2	2	2.3
	MEAN OVERALL SCORE										2.36
	RESULT										HIGH